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A STUDY OF COGNITIVE DEVELOPMENT AND PERFORMANCE IN CHILDREN WITH NORMAL AND DEFECTIVE HEARING.

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A COMPARATIVE, LONGITUDINAL STUDY WAS CONDUCTED TO EXAMINE SPECIFIC PERFORMANCE CHARACTERISTICS OF DEAF AND NORMAL CHILDREN ON SELECTED COGNITIVE TASKS. THE SAMPLE, DISTRIBUTED INTO 3 AGE CATEGORIES, CONSISTED OF 72 NORMAL AND 60 DEAF CHILDREN. MEASURES WERE SELECTED TO ASSESS THE PERFORMANCE OF SUBJECTS (1) IN DIFFERENT AREAS OF COGNITION, (2) BY LANGUAGE AND NONLANGUAGE TECHNIQUES, (3) ON INFORMATION ACQUIRED INCIDENTALLY OR PROVIDED IN A TESTING SITUATION, AND (4) WITH MEASURES THAT WERE SUITABLE FOR ADMINISTRATION TO BOTH LEARNING AND DEAF SUBJECTS. CONSERVATION TASKS (PIAGET) WERE ADMINISTERED. SEVERAL VOCABULARY MEASURES FOR ASSESSING COMMON WORD USAGE AND UNDERSTANDING WERE ALSO ADMINISTERED. ALL TESTS WERE ADMINISTERED TO EACH AGE GROUP OF NORMAL CHILDREN. WHEN REQUIRED, TESTS OF NONLANGUAGE RESPONSES WERE ADMINISTERED TO THE DEAF SUBJECTS. SYSTEMATIC ANALYSES WERE EMPLOYED TO COMPARE LONGITUDINAL CHANGES, CROSS-SECTIONAL AGE DIFFERENCES, SEX DIFFERENCES, AND RESIDENT VERSUS DAY SCHOOL DIFFERENCES (APPLICABLE ONLY TO THE DEAF CHILDREN). FINDINGS OF THESE ANALYSES SUGGESTED THAT (1) DEAF SUBJECTS TEND TO SHOW LESS INCREMENTAL LEARNING THAN NORMAL SUBJECTS, (2) DEAF SUBJECTS TEND TO VARY MORE THAN NORMAL SUBJECTS ON THE LEVEL OF THEIR PERFORMANCES AMONG DIFFERENT TESTS, AND (3) THE PERFORMANCES OF DEAF SUBJECTS, AS THEIR AGES INCREASE, TEND MORE TO MATCH AND SOMETIMES SURPASS THE PERFORMANCES OF NORMAL SUBJECTS. FURTHER RESEARCH WAS RECOMMENDED TO STUDY THE ENVIRONMENTAL FACTORS WHICH RELATE TO COGNITIVE PERFORMANCES OF THE DEAF. (RS)

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I. THE PROBLEM

For many years the inferior cognitive performance of the deaf has been quite generally accepted. More recently, however, increasing recognition has been given to the variability found in the performance of the deaf. This variability has been explored in relation to intrinsic factors, such as age of onset and degree of hearing loss, as well as in relation to extrinsic factors, such as type and difficulty level of the cognitive task. In an attempt to increase and refine understanding of cognitive development and performance, particularly in deaf children, this study was undertaken between 1958 and 1963.

The same hearing and deaf subjects were assessed on several different measures of cognitive performance over two-year intervals. Verbal and nonverbal measures were used to assess performance based on information either attained incidentally or provided in the test situation. Comparisons of changes in performance of the same hearing and deaf subjects and of hearing and deaf age groups over the age range studied were possible.

Since the area investigated is central to the learning of academic subject matter, the relevance of the study for improving the learning environment of both hearing and deaf children is self-evident. However, the potential value of the study is enhanced because the same subjects were retested after an interval of two years; because a number of cognitive areas were investigated; because characteristics of performance on some tests were examined; and because the sample spanned the elementary and junior high school years. Since the study focused upon an area in which the deaf have been found to be inferior and attempted to delineate characteristics of the variability in their performance, it has special

value for current evaluation, rethinking and research in the field of the education of the deaf.

Review of the Literature

The theoretical and research literature relevant to this study concern the major areas of cognition and reasoning, language, the interdependence of language and thought, and their development in deaf and hearing subjects. Currently many programs being instituted for the disadvantaged and the handicapped demand practical decisions in the first three of these areas. The fourth, too, is of immediate practical concern since it not only singles out one area of deviation, but also deals with the important problem of change in performance by the same subject as they get older.

A large amount of relevant literature -- research, theoretical and practical -- is available. The body of literature is large not only because of the number of areas involved in the study, but also because these areas reflect both current and long term practical and research interests in our society. No attempt has been made to summarize these materials since a thorough review of relevant literature is well beyond the purview of this report. Rather, a few references that summarize current knowledge and identify investigators and sources have been presented. In addition, appropriate references have been discussed in relation to specific measures and findings throughout the report.

The body of literature that has accumulated over the years on the development of cognition and reasoning in hearing children is large. A major summary presentation of work in this area was made by Russell (1956). Piaget has discussed the child's perception and conception of his world in a number of volumes. (Specific references to his work have been given in the discussion of the measures and the presentation of results on

Piaget tasks.) An extensive bibliography related to his work appears in Flavell (1963) and is part of a report of a recent conference on cognitive development (Kessen and Kullman, 1962).

Few studies of reasoning in hearing impaired subjects are available. The number of studies with the deaf -- the subjects of this study -- is quite limited. Recent reviews by Furth (1964, 1966) of research on the hearing impaired is tangible evidence of both the limited amount of work that has been done in the cognitive area with deaf subjects, and the growing interest in the area. Careful examination of the available research emphasizes the difficulties of attempting comparisons among the studies of the hearing and the various hearing impaired groups. The aspects of reasoning considered, the measures used in the investigations, the techniques of measurement and the characteristics, other than hearing acuity, of the samples, vary so that direct comparisons are often impossible.

A number of studies of the reasoning of subjects with impaired hearing, however, do include deaf as well as hard of hearing subjects in their samples (e.g. Farrant, 1964; Furth, 1964; Oleron, 1953, 1961; Rosenstein, 1960; Templin, 1950, 1954a, 1954b). Investigators have tended to find the deaf inferior -- although at a varying number of years -- to hard of hearing or hearing subjects of the same age. This statement is an oversimplification of the findings, however, since if attention is given to intellectual ability, environmental stimulation, specific training of the subjects in the samples, or characteristics of the cognitive tasks, more differentiating findings are reported. Data for the present study was being, or had already been, gathered when the more recent studies were published.

The amount of current and older relevant research on language de-

velopment is very extensive. Much of the earlier work was summarized by McCarthy (1954). Somewhat more recently, selective critical reviews of research on language that gave more emphasis to the contributions of linguists and psycho-linguists and to current trends in the area were published by Carroll (1960) and Ervin and Miller (1963).

Language is an area of interest to many disciplines, e.g., linguistics, psychology, anthropology, sociology, and education. Much of the older work was carried on within the framework of one of these disciplines and little interchange in methods and techniques was found among disciplines. Within the past 15 years, however, not only has a resurgence of interest in language development occurred, but the resurgence has been characterized by interdisciplinary approaches, construction of theories of language, and concern with the process rather than the product of language development. Thus, a series of hyphenated disciplines such as psycho-linguistics, socio-linguistics has developed. While early studies were apparently concerned with products such as the appearance of the child's first word (Darley and Winitz, 1961), current research and conferences emphasize processes, such as the acquisition of language (Bellugi and Brown, 1964).

At present, work on the grammatical structure of language (e.g. Brown and Bellugi, 1964; Chomsky, 1965; Greenberg, 1963) is delineating new dimensions for study and evaluation. Its impact on the study of the language performance of the deaf, however, is just beginning to be felt. McNeill (1966) has discussed some of the current work on language acquisition in relation to deaf children.

The function of language was considered extensively in the earlier work of Piaget (1926). He emphasized the shift in the function of language from the egocentric to the social with increasing age. Currently, the

function of language among children from different socio-economic and cultural backgrounds has been emphasized (Bernstein, B., 1960).

In early studies of language the size of use or recognition vocabulary was of great interest (Seashore and Eckerson, 1940; Smith, Madora E., 1926; Smith, Mary K., 1941). For a number of years interest in vocabulary study languished, but current practical questions -- associated, for example, with antipoverty and headstart programs -- have pointed up the importance of the area. Rather than size and extent of vocabulary, however, current interest is more in the specific characteristics and impact of restricted vocabulary. Some early work on the depth of understanding of meanings and use of common words is related to the present concern (Watts, 1944, Moran, 1953).

That the deaf are inferior in the extent of vocabulary has been reported by a number of investigators (Cooper and Rosenstein, 1966). The depth of understanding of words has only recently begun to be explored with deaf children. MacGinitie (1965) studied alternative meanings of words in hearing children in grades 4 through 8, and in deaf subjects between 9 and 20 years. Using a specially devised test that attempted to measure the ability of his subjects to shift readily from one conceptual set to another when required to find an appropriate meaning for a multiple meaning word, MacGinitie found that the context of the item had essentially no effect on the performance of deaf subjects.

While a substantial number of studies have investigated the language production of the deaf, fewer and less intensive studies have been made of the process and products of language development in the deaf. In one of the early studies of written language of the deaf, Heider and Heider (1941) considered variables such as length of sentence, grammatical accuracy, amount and type of subordination, etc. They reported that the

deaf were essentially like younger hearing children in their written language with one or two exceptions, such as the use of conditional clauses. Recently Cooper and Rosenstein (1966) have summarized the findings of studies of language of the deaf as follows:

> The retardation exhibited by deaf children in their language has been described by various investigators in terms of achievement test scores and analyses of written language samples. Deaf children have been found to be markedly retarded in their achievement test scores. Their written language, compared to that of hearing children, was found to contain shorter and simpler sentences, to display a somewhat different distribution of the parts of speech, to appear more rigid and more stereotyped, and to exhibit errors or departures from standard English usage (p. 66).

Nevertheless, some studies have found the deaf resembling the hearing on certain dimensions of language, e.g. in quantity of verbal output in some lexical categories (Simmons, 1962, 1963) and in spelling (Templin, 1948). It is probable that the language environment and the educational philosophy of the school from which the sample is drawn are factors in the findings, but, for the most part, they are not considered as variables in any of the studies.

That few of the published studies on the language of the deaf have been related to current linguistic theory and methods is not surprising. However, within the last few years, a number of studies with the deaf have been undertaken that are concerned with the characteristics of their word associations and understandings of words (Blanton and Nunnally, 1965; Fremer and MacGinitie, 1965; Restaino, 1965; and Rosenstein and McGettigan, 1965).

Concern with teaching language to the deaf has long constituted a major concern for persons responsible for their education. An excellent historical overview of ideas and techniques in language instruction that attempt to "put present efforts in proper perspective and point to

future ways and means of developing language" was recently published (Schmitt, 1966, p.87).

Despite the increased interest since the 1930's in language, perception, and cognition of children with defective hearing, still relatively little research on language and reasoning of the deaf is available. There does seem however to be almost unanimous agreement among the few investigators that children with defective hearing are inferior to hearing children of the same age in these areas. More recent studies in language have attempted to move away from a global acceptance of inferiority in the deaf and to delineate degrees of inferiority (or lack of it) in specific areas as they are affected by characteristics associated with the hearing loss, by experience, or by definable environmental conditions.

In recent years the old question of the interdependence of language and thought has again come to the fore. Vygotsky (1962) has set forth strong evidence and arguments for the dependence of thought upon language. On the other hand, there are numerous reports of reasoning tasks being carried on by subjects lacking seemingly related language skills (Eberhardt, 1940; Lenneberg, 1962).

In this study cognitive performance was assessed through measures developed and used by other investigators. In the presentation of the measures and the findings reference has been made to the relevant work of these investigators.

Objectives

This study was undertaken with the broad objective of increasing understanding of the variation in performance and development in different cognitive tasks of deaf subjects in comparison with hearing subjects. More specifically it attempted to:

1. To determine the longitudinal changes that occur over a two-year period in the performance of the same hearing and deaf subjects on selected cognitive tasks, and to compare the changes that are found for the deaf and the hearing.

2. To determine in cross-sectional comparisons with the hearing the extent and the variability of the inferiority of the deaf on cognitive tasks selected to measure several areas of cognition with testing techniques using language and nonlanguage responses.

3. To delineate some specific characteristics of the performance of deaf and hearing subjects on selected cognitive tasks.

The predictions that follow were the major determinants of how the data were analyzed. This report, however, does not include all the analyses that have been or that should be made on the data gathered.

Predictions

1. Deaf subjects at each age are inferior to hearing children in cognitive performance, and they become progressively more inferior at the older ages.

1.1 Inferiority of the deaf subjects is less when the measures are based on information presented in controlled testing situations.

1.2 Inferiority of the deaf subjects is greater on measures that are based on concepts and generalizations usually attained in everyday experiences.

1.3 Inferiority of the deaf subjects is greater on measures in which language responses are a necessity.

1.4 Inferiority of the deaf subjects is greater in any area when the task is more complex.

2. In the longitudinal development of cognitive performance, deaf

children show less significant increase in performance over a two-year period than hearing children.

Design of Study

The investigation was a modified longitudinal design. In it, samples of hearing and deaf children were tested twice: at the first testing session when they were approximately 6, 9, and 12 years of age; and at the second testing session when they were approximately 8, 11, and 14. The testing schedule for the total sample was as follows:

	First Testing Session	Second Testing Session
Hearing Sample	1959-1960	1961-1962
Deaf Sample	1960-1961	1962-1963

In this report, total sample has been used to refer to all subjects in the investigation. Sample refers to the deaf subjects or the hearing subjects alone. Group designates the hearing or deaf subjects in a specified age category at a given testing session, e.g., youngest deaf subjects at the second testing session. Subgroup designates a part of a group, e.g., youngest deaf subjects at the second testing session who attended a residential school, or boys in a given age group.

Throughout the report, the system of notation followed consists of an identifying letter for the sample, H for the hearing and D for the deaf, followed by one or two digits in parentheses. One digit alone refers to the age category of the subjects, i.e., (1) the youngest, (2) the middle, (3) the oldest. When two digits are enclosed in the parentheses, the first refers to the age category and the second to the first or second testing session. Thus the youngest hearing group at the second testing session is designated H(12); the oldest deaf group at the first testing session D(31); etc. In those instances in which the explicit age of the group is of particular value, the information is given in the following form, H(11):CA 6.

Insofar as possible, comparisons were systematically made throughout the study between certain deaf, certain hearing, and certain hearing and deaf age groups.

For the longitudinal purposes of the study, the performance of each hearing and deaf group on the first testing session was compared with its performance on the second testing session whenever possible. Thus the following longitudinal comparisons of performance by the same subjects over a two-year span were made: H(11)-H(12):CA 6-8; H(21)-H(22): CA 9-11; H(31)-H(32):CA 12-14; D(11)-D(12):CA 6-8; D(21)-D(22):CA 9-11; D(31)-D(32):CA 12-14.

A number of sex and age comparisons both within and between the hearing and the deaf samples were also made quite systematically. The number of meaningful comparisons that could be made was very large, but those selected as probably most meaningful were carried out within the limitations permitted by the specific tests administered to the several groups. One group of such comparisons involved only cross-sectional data and compared the performances of boys and girls within the deaf sample, within the hearing sample, and between the deaf and hearing samples at the same age levels.

A series of age comparisons were made within the deaf and within the hearing samples as follows: (a) Comparisons over one year were made between pairs of age groups one of which was tested at the first and the other at the second testing session, H(12)-H(21):CA 8-9; H(22)-H(31): CA 11-12; and insofar as possible between the same D age groups. (b) The comparisons over a two-year span were the longitudinal comparisons described above. (c) Comparisons over a three-year span between different age groups tested at the first or second testing session, H(11)-H(21):CA 6-9; H(21)-H(31):CA 9-12; H(12)-H(22):CA 8-11; H(22)-H(32):CA

11-14; and the same comparisons for the D age groups insofar as possible.

Comparisons between the hearing and deaf were made (a) for groups of the same age, and (b) for each D age group tested and the oldest and youngest hearing groups. Additional age comparisons were made for certain of the measures.

Performances were compared between deaf subjects attending day and resident Schools, and between these subgroups of deaf subjects and the hearing subjects in comparable age groups, when such analyses were warranted.

Treatment of the Data

Because of the nature and the purpose of the study, frequently no statistical tests were applied to the data presented. For the most part, however, the data collected were analyzed primarily as comparisons within and between hearing and deaf age groups. Quantitative and classification scores were obtained on all measures as described in Section III. For calculations on measures yielding quantitative scores, Student's *t*, was used. For calculations on measures yielding qualitative scores, significance of differences of proportions, McNemar's Test for Significance of Changes (Siegel, 1956, p. 63) and Fisher's Exact Probability Test (Siegel, 1956, p. 96) were most frequently used. Although for some computations data were computer processed at the Numerical Analysis Center of the University of Minnesota, some computations were also carried out on hand calculators.

In the calculation of *t* values, the formula for uncorrelated means was used throughout although in many instances the same measures were repeated with the same subjects after a two-year interval. The two-year span between testing was deemed a period of time sufficient that, on the whole, the tests could be considered as new. Every attempt was

made to select tests appropriate to the deaf and hearing at the age levels tested and to administer them as adequately as possible. There is no doubt, however, that some of the tests were more appropriate for the hearing and the older subjects than for the deaf and the younger subjects and that the testing of the youngest deaf particularly was probably less adequate than that of the other groups. The coefficients of correlation between the first and second administration of the different tests varied considerably from test to test and for the several age groups. The correlations within the deaf sample were more variable than those within the hearing samples.

It was decided to use the formula for uncorrelated measures since this would tend to decrease the number of observed differences found significant at a given level of confidence. I did not wish in this study to maximize the occurrence of observed differences.

On all tables, (*) indicates the .05 and (**) the .01 level of confidence. In the discussion, however, the .01 level is considered significant. To facilitate interpretation of results, the <u>t</u> value for each N used in the systematic comparisons at the .05 and .01 levels of confidence, based on a two-tailed distribution, are presented in Table A-I-1.

II. THE SAMPLE

The hearing and deaf subjects for whom test data were essentially complete for both testing sessions made up the final sample, 72 hearing (H) and 60 deaf (D) children. They were distributed into three age categories, designated by (1) for the youngest, (2) for the middle, and (3) for the oldest age groups. At the first testing session, the subjects in these categories were approximately 6, 9, and 12 years of age, respectively; at the second testing session they were approximately 8, 11, and 14 years of age.

All the hearing subjects were enrolled in the Minneapolis public schools. The deaf subjects were selected from among children enrolled in special classes for the hearing impaired in the Minneapolis Public Schools, the St. Paul Public Schools, and the Minnesota State School for the Deaf in Faribault, Minnesota. The latter is a resident school for the deaf; the Minneapolis and St. Paul schools are day schools.

Table 2.1 presents the number of subjects in the total sample by age groups and, for the deaf, by type of school. The number of D (1) girls is particularly small but it is all the subjects from the population that could be included in that age group.

Table 2.1. Number of Hearing and Deaf Boys and Girls in Total Sample by Age Groups, and for Deaf Subjects by Type of School.

	Hearing Sample		Deaf Sample					
					Day School		Resident School	
Age Group	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
(1)	12	12	13	4	7	1	6	3
(2)	13	11	10	9	4	2	6	7
(3)	12	12	15	9	8	5	7	4
Totals	37	35	38	22	19	8	19	14

Selection of Subjects

To select the deaf subjects, the school records at the Minneapolis and St. Paul day schools for the deaf and at the Minnesota State School for the Deaf, a resident school, were searched to locate children born in 1948, 1949, 1951, 1952, 1954, and 1955. From each of their records available data were systematically obtained on birthdate, grade, father's occupation, cause of deafness, age of onset of deafness, audiometric test results, and handicapping conditions other than hearing loss. All children born during these years who were enrolled in a special class or school, whose deafness was congenital or had occurred before two years of age, and who had no other known handicapping condition were considered potential subjects. It was possible to identify 65 suitable deaf subjects for the first testing session: 20 in the youngest (1), 19 in the middle (2), and 26 in the oldest (3) age categories.

To select the hearing sample, the names, birthdates, grades, and fathers' occupations were obtained on all children enrolled in six Minneapolis schools in middle- to lower-middle-class neighborhoods, who were born in 1947, 1948, 1950, 1951, 1953, and 1954. Using a technique of random numbers, 92 children with appropriate birth dates were selected for the first testing session: 30 for the youngest age group (1) from the pool of approximately 1000 children born in 1953 and 1954; 32 for the middle age group (2) from the pool of about 900 born in 1950 and 1951; and 30 for the oldest age group (3) from the pool of about 600 born in 1947 and 1948. All hearing children so selected were enrolled in regular classes and none was known to have a handicapping condition.

Although the hearing children were selected from schools that paralleled the socio-economic background of the deaf subjects, no attempt was made to match hearing and deaf subjects individually on the factors

of intelligence, grade placement, and grade achievement.

Lost Subjects

The number of subjects in the deaf sample was reduced from the 65 tested in the first session to 60 at the second testing session. Of the five children not included in the final deaf sample, one was removed from the state, one, after the initial testing session, was found to have cerebral palsy, and three were eliminated because they had excessive difficulties with various measures in the first testing session.

The number of subjects in the hearing sample was reduced from 92 tested at the first session to 72 in the final sample. Fifteen children were lost for uncontrollable reasons: 13 were moved from the state, one had a serious accident that resulted in a long illness between testing sessions, and one was referred to the Child Study Division of the Minneapolis Public Schools for intensive personality study; and five subjects were eliminated by a random-numbers technique to equalize the number of subjects in each hearing age group: three children from the middle, and two from the oldest, age groups.

Thus, of the subjects tested at the first testing session, less than 2 per cent of the deaf and 15 per cent of the hearing were not available at the second testing session. The greater stability of the deaf sample may reflect the effects of the 1957 Minnesota statute (Special Education Law) that made mandatory on school districts provision for the education of the handicapped,as well as the availability of few good educational programs for children with hearing impairments, and the consequent reluctance of parents to remove deaf children from specific programs. The greater loss of hearing children from the sample may reflect, in part, the large number of good educational facilities available for them and consequent parental freedom in moving about.

Hearing Acuity

According to group audiometric tests administered in the public schools, the subjects in the hearing sample had no known significant hearing losses.

A child was included in the deaf sample only if, at the first testing session, he was in a special class for the impaired hearing and either (1) had a mean hearing loss of at least 60 decibels over the speech range (frequencies 500, 1000, and 2000) in the ear in which he had the most hearing; or (2) when no audiogram was available, had been reported as deaf by an audiologist or otologist. By the end of the second testing session audiograms were available on all children.

The most recent audiogram available at the end of the second testing period was used to calculate the mean decibel loss over the speech range in the ear exhibiting the least loss. In Table 2.2 this loss is presented by sex, type of school, and age groups. In the calculations a constant 110 decibels was used at each frequency when no response was obtained, since some children reported responses to 100 decibels.

Table 2.2. Mean Decibel Loss in the Speech Range (Frequencies 500, 1000, 2000) in Ear with Most Hearing for Deaf Sample by Sex and by School, by Age Groups.

Age Group	Boys	Girls	Sexes combined	School: Day	School: Resident
D(1)	97	90	91	94	88
D(2)	90	90	90	87	91
D(3)	81	84	83	79	86

In Table 2.2, it is seen that the mean hearing loss by age group, sex, and resident or day school enrollment was similar and substan-

tial.[1] No significance of the differences were calculated since a mean loss of approximately 80 decibels is a severe hearing loss. Statistical significance, or lack of it, between mean decibel losses of this magnitude would have little meaning in characterizing the ability of the subjects to hear speech.

Chronological Age

The mean CA for both the hearing and deaf samples of boys and girls, and the boys and girls combined, are presented in Table 2.3. Also given are the t values obtained in comparisons between the hearing and deaf boys and girls for the different age groups. The only significant differences were found in the oldest age group (3): The D(3) boys and the combined sexes were significantly older than their H(3) counterparts. The D(3) resident boys and girls combined were about 3½ months younger than their day-school counterparts, while D(1) and D(2) resident subgroups were about 1½ and 2 months older, respectively, than the comparable day school subgroups.

The range in age for the D(3) group was considerably larger than that for any other group. As noted in Table 2.3, the ranges in age for the D(1), D(2), H(1), and H(2) groups were quite comparable (14 and 17 months for the hearing age groups, and 11 months for each of the deaf age groups), and the range in age for the H(3) group was only four

1 At the end of the study, when the testing and much of the analysis had been completed, two boys in the D(3) group were found to have a mean loss of only 48 and 53 decibels in the ear with the most hearing. Their position in relation to other D(3) subjects was checked in all background items and test scores. Their performances fell within the range of scores in all but a very few instances, none of which was sufficiently divergent to change the differences in the performance of deaf and hearing subjects significantly. Consequently, the two children were retained in the sample; while they were not as severely deaf as the other deaf children, their hearing losses were substantial.

Table 2.3. Mean CA at First Testing Session of Hearing and Deaf Boys, Girls and Combined Sexes by Age Groups, and Significance of Differences between Groups.

	Hearing				Deaf				
	N	Range in Months	$\overline{X}$	SD	N	Range in Months	$\overline{X}$	SD	t[1]
Age Group									
Boys									
(1)	12	73-86	78.55	3.63	13	73-83	77.28	3.09	0.93
(2)	13	107-122	114.27	4.83	10	108-119	111.80	3.55	1.35
(3)	12	142-147	144.36	1.24	15	143-164	152.08	6.80	3.86**
Girls									
(1)	12	72-86	78.39	4.25	4	72-81	76.50	4.66	0.75
(2)	11	106-123	113.35	5.51	9	108-117	113.66	2.78	0.15
(3)	12	142-145	143.78	1.11	9	142-156	146.54	5.00	1.87*
Combined									
(1)	24	72-86	78.47	3.91	17	72-83	77.09	3.37	1.18
(2)	24	106-123	113.88	5.11	19	108-119	112.62	3.27	0.93
(3)	24	143-147	144.07	1.19	24	143-164	149.96	6.64	4.27**

H(1)	Boys	compared	with	H(1)	Girls	0.10
H(2)	"	"	"	H(2)	"	0.43
H(3)	"	"	"	H(3)	"	1.21
D(1)	Boys	compared	with	D(1)	Girls	0.39
D(2)	"	"	"	D(2)	"	1.26
D(3)	"	"	"	D(3)	"	2.11*

[1]Underlining indicates a higher mean age for the deaf.

months. For the D(3) group, however, the range was 21 months. This wider range in age among the oldest deaf reflects the pattern of births of de f children during the years from which subjects were selected. There seemed to be a period in which fewer deaf boys were born, consequently, in order to obtain an adequate number of subjects in the D(3) group, it was necessary to include children born over a period of more months.

Socio-economic Status

The distribution of the occupations of the subjects' fathers, according to the Minnesota Scale for Paternal Occupations[2] is presented in Table 2.4.

Table 2.4. Frequency Distribution of Socio-economic Status for Hearing and Deaf Subjects on the Minnesota Occupational Scale.

		Socioeconomic Class[1]						
Age Group	N	I	II	III	IV	V	VI	VII
Hearing Boys								
(1)	12	0	0	3	0	5	4	0
(2)	13	0	0	2	0	6	5	0
(3)	12	0	0	3	0	6	3	0
Hearing Girls								
(1)	12	0	1	3	0	6	2	0
(2)	11	0	0	5	0	3	2	1
(3)	12	1	0	4	0	5	2	0
Combined Hearing								
(1)	24	0	1	6	0	11	6	0
(2)	24	0	0	7	0	9	7	1
(3)	24	1	0	7	0	11	5	0
Deaf Boys								
(1)	13	0	0	4	2	4	3	0
(2)	10	0	0	3	2	4	1	0
(3)	15	0	1	4	3	4	2	1
Deaf Girls								
(1)	4	0	0	0	1	2	1	0
(2)	9	0	0	3	2	3	1	0
(3)	9	0	1	1	1	4	2	0
Combined Deaf								
(1)	17	0	0	3	3	7	4	0
(2)	19	0	0	6	4	7	2	0
(3)	24	0	2	5	4	8	4	1

[1] Class I, Professional; Class II, Semiprofessional and managerial; Class III, Clerical, skilled trades, and retail business; Class IV, Rural; Class V, Semi-skilled occupations, minor clerical positions, and minor business; Class VI, Slightly skilled trades and occupations requiring little training; Class VII, Day laborers.

[2] Published by the Institute of Child Development, University of Minnesota, Minneapolis, Minn. 55455.

There is substantial similarity in socio-economic classification among the various groups by age and sex. This was to be expected since the hearing sample was drawn from schools that had been selected to reflect the socio-economic distribution of the deaf subjects. Ninety-five per cent of the subjects were in socio-economic classes III through VI and over 60 per cent, in Classes V and VI. It was expected that none of the fathers of children attending the Minneapolis and St. Paul public schools would fall in Class IV, Rural Dwellers. Of the 23 deaf children attending the resident school, however, 11 (7 boys and 4 girls) were the children of farmers.

Intelligence

The intelligence of all subjects in the total sample was evaluated by the Wechsler Intelligence Scale for Children (WISC) and the Draw-a-Man Test, using the Goodenough-Harris scoring system (Harris, 1963).

WISC

Both scales of the WISC were given to the hearing children so that three IQ scores were available for them: Performance IQ, Verbal IQ, and Full Scale IQ. Only the Performance Scale was administered to the deaf sample. The mean IQ's obtained by the children are given in Table 2.5, by scale, sex, age, and hearing categories.

All groups means fell within the normal range of intelligence. The lowest mean was found for the D(2) girls. The differences in the mean Performance IQ between hearing and deaf subjects of the same age groups were not significant. Nor were significant differences found between boys and girls in the hearing and deaf age groups. However, the deaf boys consistently obtained higher mean Performance IQ's than the deaf girls in the same age groups.

For both the Verbal and the Full Scale IQ's, there were no signi-

Table 2.5. WISC Scales. Mean IQ at First Testing Session for Hearing and Deaf Boys, Girls, and Combined Sexes by Age Groups, and Significance of Differences.

	Hearing			Deaf			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t[1]
Performance IQ							
Boys							
(1)	12	101.17	15.89	13	104.15	14.56	0.51
(2)	13	105.38	9.07	10	102.80	10.47	0.63
(3)	12	104.92	11.89	15	107.86	13.95	0.58
Girls							
(1)	12	109.50	9.60	4	96.50	15.97	1.99
(2)	11	104.45	9.10	9	89.66	14.57	2.78*
(3)	12	106.25	10.74	9	102.44	11.23	1.04
Combined							
(1)	24	105.33	13.54	17	102.35	14.76	0.67
(2)	24	104.96	8.87	19	96.58	13.95	2.40*
(3)	24	105.58	11.09	24	105.83	13.02	0.07

H(1) Boys compared with H(1) Girls	1.55
H(2) " " " H(2) "	0.25
H(3) " " " H(3) "	0.29
D(1) Boys compared with D(1) Girls	0.90
D(2) " " " D(2) "	2.27*
D(3) " " " D(3) "	0.99

- -

	Hearing Boys			Hearing Girls			
Verbal IQ							
(1)	12	97.16	15.05	12	98.58	10.29	0.27
(2)	13	103.15	7.06	11	104.09	8.64	0.29
(3)	12	103.25	16.04	12	106.00	12.56	0.47
Full Scale IQ							
(1)	12	99.17	16.03	12	104.00	8.25	0.93
(2)	13	104.69	7.09	11	104.45	8.20	0.08
(3)	12	104.50	12.94	12	106.75	10.62	0.47

[1] Underlining indicates higher mean scores for boys in boy-girl comparisons and for deaf in hearing-deaf comparisons.

ficant differences between hearing boys and girls.

Although the day school deaf measured consistently higher Performance IQ's than the resident deaf, the difference at no age was statistically significant (Table 2.6).

Table 2.6. WISC Performance Scale. Mean IQ and Significance of the Differences between Resident and Day School Deaf Subjects at First Testing Session by Age Group.

	School: Day			School: Resident			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Age Group							
(1)	8	111.50	10.81	9	94.20	13.25	2.92*
(2)	6	106.83	8.52	13	91.85	13.60	2.47*
(3)	13	107.15	11.58	11	104.27	14.97	0.53

Comparison of the mean Performance IQ's of comparable hearing and day school deaf age groups revealed no significant differences (t = 1.17, 1.50, 0.41). The resident deaf had lower mean Performance IQ's than the hearing subjects at a significant level for the middle (2) age group (t = 3.55), but not for the youngest and the oldest age groups (t = 2.11 and 0.29 respectively).

Except in one instance, all differences in mean Performance IQ at given age levels that were significant or reached the .05 level of confidence occurred in the deaf middle age sample (2): These differences are probably attributable to the Performance IQ's obtained by two D(2) resident school girls. Both girls obtained IQ's on the Draw-a-Man sufficiently higher to place in doubt the WISC Performance IQ obtained.

Draw-a-Man Test

In order to obtain another evaluation of the nonverbal intelligence of the subjects in the sample, a Draw-a-Man picture and Draw-a-Self picture were obtained from each child at each testing session. The

four drawings were scored according to the Harris (1963) revision of the Goodenough point scale. For this report, however, only the IQ based on the Draw-a-Man picture obtained in the first testing session was used in the description of the sample: First, because the drawing of a man is more frequently used as an intelligence measure than the drawing of the self, and second, because the age range of the sample at the first testing session -- 6 to 13 -- fell more nearly within the age range for obtaining reliable scores for the measure than the age range at the second testing session.[3]

Table 2.7 presents the mean IQ based on the Draw-a-Man test given at the first testing session for the boys and girls in each group, and the significance of the differences between hearing and deaf boys, girls and sexes combined, and between hearing boys and girls, and deaf boys and girls.

Unlike the WISC Performance IQ, a significant difference between the deaf and hearing samples was found between H(1) and D(1) on the Draw-a-Man. There were no significant differences between the mean IQ's of boys and girls in any age group, in either hearing or deaf samples. An examination of the scores, however, revealed that for both the hearing and deaf boys, the middle age samples (2) obtained the highest IQ scores. For the hearing girls, however, the scores decreased with age level from a high at the H(1) to a low at H(3); by contrast, the scores for the deaf girls increased with age from a low at D(1) to a high at D(3). The difference in trend is reflected in the significant *t* value between scores for D(1) and H(1) girls.

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3 No further reference to the drawings of a man and of self obtained at the two testing sessions will be made in this report, but an analysis of the quality and point scales used in scoring the drawings, and the longitudinal comparison of the scores obtained on the two sessions for the drawings of man and self will be reported separately.

Table 2.7. Draw-a-Man Test, Mean IQ at First Testing Session for Hearing and Deaf Boys and Girls and Boys and Girls Combined by Age Groups, and Significance of Differences.

	Hearing			Deaf			
Age Group	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t[1]
Boys							
(1)	12	90.21	14.30	13	84.82	12.90	0.99
(2)	13	97.59	18.40	10	93.10	10.12	0.69
(3)	12	93.05	13.40	15	88.51	12.10	1.08
Girls							
(1)	12	98.46	12.90	4	72.25	10.53	3.65**
(2)	11	95.08	11.70	9	80.66	22.00	1.88
(3)	12	89.21	15.50	9	94.77	12.30	0.88
Combined							
(1)	24	94.45	13.90	17	81.85	13.25	2.90**
(2)	24	96.54	15.40	19	88.21	17.50	1.65
(3)	24	91.24	14.30	24	90.91	12.30	0.88

H(1) Boys compared with H(1) Girls	1.48
H(2) " " " H(2) "	0.39
H(3) " " " H(3) "	0.64
D(1) Boys compared with D(1) Girls	1.77
D(2) " " " D(2) "	1.61
D(3) " " " D(3) "	1.22

1 Underlining indicates a higher mean IQ's for boys in boy-girl comparisons, and for deaf in hearing-deaf comparisons.

No significant differences were found in comparing the mean Draw-a-Man scores of the day school deaf and the resident school deaf (Table 2.8. Except for the youngest day school and resident school age samples, the mean difference in scores was less than one point.

Table 2.8. Draw-a-Man Test, Mean IQ at First Testing Session for Day School and Resident School deaf Subjects by Age Groups, and Significance of Differences.

	Day School Deaf			Resident School Deaf			
Age Group	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
(1)	8	85.63	17.33	9	78.56	7.89	1.10
(2)	6	86.50	9.22	13	87.54	20.65	0.12
(3)	13	90.54	12.26	11	91.18	12.99	0.12

Comparison between the WISC and the Draw-a-Man Test

The coefficients of correlation between WISC Performance IQ and Draw-a-Man Test IQ for the deaf age groups are considerably higher and more frequently statistically significant than most of the correlations for the hearing age groups (Table 2.9). This difference suggests that nonverbal tests are a better measure of intelligence for the deaf than they are for the hearing. The magnitude of the correlations for the middle hearing age group emphasizes that nine years approximately is an optimal age for performance on the Draw-a-Man Test for hearing children.

Table 2.9. Coefficients of Correlation between IQ's for Hearing and Deaf Subjects on the WISC and on the Harris Draw-a-Man Test, by Age Groups.

	Age Group					
Draw-a-Man IQ versus:	H(1)	H(2)	H(3)	D(1)	D(2)	D(3)
WISC Performance IQ	.42	.41	.17	.64*	.56*	.67**
WISC Verbal IQ	.00[a]	.41	.14			
WISC Full Scale IQ	.22	.51*	.18			

[a] .000251

Consistently higher mean IQ's were obtained for all sex and age groups with the WISC Performance scale than with the Draw-a-Man Test.

Teacher Rating

Each hearing and deaf subject was rated by his teacher at the close of the second testing session. The teacher was presented a form for each child that is here presented.

> The above named child has been a subject in a study on the development of reasoning. Would you please fill in the following information about the child based on your observations and experiences with him or her during the 1963-64 school year. For the three scales place a check at any point within the space between the defined extremes where you believe this child to fall.
>
> 1. Intellectual curiosity:
>
> | Is not curious | Is moderately curious | Is extremely curious |
> |---|---|---|
>
> 2. Solving of problems in which the use of language is a major component:
>
> | Depends on outside help | Accepts outside help | Does not accept outside help |
> |---|---|---|
>
> 3. Solving of problems in which manipulation and construction of materials are the major components:
>
> | Depends on outside help | Accepts outside help | Does not accept outside help |
> |---|---|---|

The checks were assigned numbers from *1* to *7*. The mean rating given the subjects by age groups is presented for Items one to three in Table 2.10. It is apparent that the mean rating for the children in all groups is near or below the middle of the range on all items.

Table 2.10. Mean Teacher Rating on Curiosity and Problem Solving Behavior of Deaf and Hearing Subjects by Age Groups.

	Hearing			Deaf		
Item	1	2	3	1	2	3
Age Group						
(1)	3.5	2.9	3.2	4.0	2.8	3.5
(2)	3.9	3.8	3.9	3.2	3.1	3.3
(3)	4.3	4.0	3.8	2.5	2.4	2.8

There was a tendency for the teachers of the hearing to see the children at the older age levels as more curious and more independent in problem solving that involved both language and manipulation than children at the younger age levels. The teachers of the deaf, however, saw the deaf children at the older age levels as less curious and more dependent in problem solving that involved both language and manipulation than younger subjects. Progression from dependence to independence in a number of behavioral areas has long been recognized as characteristic of a child's growth from infancy to childhood to adolescence. Thus the ratings of the teachers of the deaf may be interpreted to mean that they see older deaf children as immature for their ages.

Summary Discussion

In order to make longitudinal comparisons, the final sample was determined by the subjects that remained available at the termination of the study. The descriptive measures of the final deaf and hearing samples as previously presented indicated that reasonably satisfactory deaf and hearing samples were maintained. On the whole, the deaf and hearing samples were of comparable age, socio-economic status and intelligence.

That the deaf sample is less satisfactory than the hearing sample is seen in the small number of youngest deaf girls; the greater chronological age and greater range of age of oldest deaf boys and the probably somewhat less reliable WISC Performance and Draw-a-Man IQ's of the D(1) and D(2) girls, respectively.

One problem associated with a longitudinal study is that of maintaining an adequate sample over the entire period of the study. In the present investigation it was easier to maintain the deaf sample than the hearing sample. Only one deaf child as compared to 13 hearing children was removed from the geographical area. This stability of the deaf subjects is an asset for longitudinal study. It may reflect the high quality of Minnesota's opportunities for education of the deaf. It may also reflect the sociocultural status and personality characteristics of parents, as well as their evaluation of the importance of known educational opportunities for their hearing impaired children.

The characteristics of the final deaf sample reflect the general difficulties associated with obtaining, as opposed to maintaining, an adequate sample of deaf subjects. Since the deaf population is much smaller than the hearing population, the criteria established for sample selection were defined in terms of inclusion rather than exclusion in order not to make ineligible too many members of the small population of potential subjects. In this study, for example, the entire population of deaf children born within certain years and enrolled in three Minnesota secondary programs[4] served as potential subjects. Yet is was necessary to include boys in the D(3) group from the extremes of

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[4] These three programs account for the education of about 90 per cent of the secondary school deaf children in the state of Minnesota (State Department of Education, 1964, p. 125).

a range of 143 to 164 months in order to obtain 12 suitable subjects; and the _N_ of 4 in the group of youngest deaf girls represented all identified girls meeting the broad criteria for inclusion who were able to cooperate in the first testing session.

Information on many variables that should be controlled in the selection of a sample is not readily obtained. The etiology of deafness, for example, is known to have a differential effect on the performance of the deaf, and yet it was not considered. In an earlier study in Minnesota (State Department of Education, 1964, p. 129), it was found that records of etiology of deafness were inadequate: for 23.4 per cent of the 590 subjects the cause of deafness was listed as congenital with no distinction made between genetic deafness and deafness caused by intrauterine or birth accidents. And for 46.9 per cent, the etiology was listed as "unknown." The availability of standard achievement test scores for the deaf would be valuable, but the same measures are not systematically given in the several programs.

Even with extensive examination of a child, it is often difficult to determine whether the overt impairment is or is not accompanied by other impairments. Consequently, in a study in which the investigator is necessarily dependent upon available school records for information on characteristics of subjects, there is always the possibility that influential variables have not been identified or noted. Children with known gross symptomatology were not included in the original sample. Nevertheless, five were lost because of symptoms that were not recognized at the time of initial selection. The failure of three other children to perform adequately on the first testing session could have resulted from a poor understanding of language, undetected brain damage, mental retardation, aphasia, or some emotional disturbance. There is no way of knowing how many children remaining in the study performed the way they did because

of some minimal effects of these same variables.

Intelligence was not made a criterion in selecting the sample since no test for measuring intelligence is equally valid and reliable for both the deaf and hearing. The assessment of the intelligence of the deaf presents a number of problems. Although it has long been recognized that verbal measures are less adequate than nonverbal measures, it is more recently accepted that not all nonverbal measures can be equated in their use with the deaf. It has also been emphasized that verbality and nonverbality are not discrete categories, and that the types of reasoning processes necessary for successful performance in both types of tests may be either singly, jointly, or proportionally involved in measures classified as verbal or nonverbal (Myklebust, 1964).

Comparisons between children with and without hearing losses and in different school settings are problematical at best. The very nature of the difference in experiences of a child with hearing and a child without hearing imposes limits on the comparisons that can be made between their performances. Similarly, the very nature of life in an institution and in a family setting results in different peer group and child-adult experiences. It may be that the results of any cognitive study involving deaf children must ultimately be evaluated in the light of the environmental and educational stimulation to which they have been exposed.

III. THE MEASURES

In this section are presented the measures used in the investigation, and the general procedures followed in their administration. Some of the measures were standard, others were research instruments that may be unfamiliar or are not readily available. For each measure, the purpose, description, general administration procedures, modifications for the deaf, and scoring procedures are given. When relevant, additional detailed information on the different tests and copies of some of the tests have been included in Appendix B.

Selection of Measures

The measures used in the study were selected according to the following four criteria and are so classified in Table 3.1.

Criterion 1. Different areas of cognitive development should be measured. Selected for measurement from among the many aspects of cognition were the following areas: spatial relations, classification, conservation, vocabulary, and formulation of a principle.

Criterion 2. Techniques of measurement should include instruments in which language and nonlanguage responses are necessary. Measures in which the response was essentially a nonverbal one are designated as nonlanguage, and measures in which the response was essentially verbal are designated as language. In both language and nonlanguage measures, however, the ability to conceptualize in the area measured is probably basic.

Criterion 3. The level of performance based on information attained incidentally in day to day experiences, and the ability to perform on

the basis of information provided in a controlled testing situation should both be sampled. These divisions should be considered as generally descriptive categories rather than as representative of a rigid dichotomy of testing conditions. They do indicate the major emphases of the testing situations, however.

Table 3.1. Classification of Measures According to Three Criteria of Selection for Inclusion in Study.

Measure	Criterion 1: Cognitive Area Tested	Criterion 2: Testing Channel	Criterion 3: Performance Measured
Progressive Matrices	Spatial Relations	Nonlanguage	Controlled
Color Form Sorting	Classification	Nonlanguage	Controlled
Color Sorting	Classification	Nonlanguage	Controlled Incidental
Equality of Angles	Formulation of Principle	Language Nonlanguage	Controlled
Four Piaget Tasks	Conservation	Language	Incidental
Multiple Meaning of Words	Vocabulary	Language	Incidental
Six Moran Word Tests	Vocabulary	Language	Incidental

Criterion 4. Insofar as possible, the measures should be suitable for administration to both deaf and hearing subjects, and to children ranging in age over the elementary and junior high school years, i.e., from relatively young children to early teenagers. The number of tests suitable for such administration is limited. Since it was not the purpose of this investigation to develop measures, an *a priori* choice of instruments was made from those available. In a few instances, it was necessary to adapt such tests to make them suitable for administration

to the total sample.

The same tests were given to the total sample whenever possible. It was found, however, that some tests were not suitable for specific age groups, for use in retesting, or for the deaf. Table 3.2 indicates the measures included in the analyses presented in this report, and the age groups to which they were administered.[1]

Table 3.2. Schedule of Administration of Measures to Deaf and Hearing Group.

	Hearing						Deaf					
Group:	(11)	(12)	(21)	(22)	(31)	(32)	(11)	(12)	(21)	(22)	(31)	(32)
CA:	6	8	9	11	12	14	6	8	9	11	12	14
N:	24	24	24	24	24	24	17	17	19	19	24	24
Progressive Matrices												
Part I (A, A_B, B)	x	x	x	x	x	x	x	x	x	x	x	x
Part II (A, A_B, B)	-	--	x	x	x	x	-	-	x	x	x	x
Color Form Sorting	x	x	x	x	x	x	x	x	x	x	x	x
Color Sorting	x	x	x	x	x	x	x	x	x	x	x	x
Conservation of Number	x	x	x	x	x	x	-	x	x	x	x	x
Conservation of Substance	x	x	x	x	x	x	-	x	x	x	x	x
Conservation of Weight	x	x	x	x	x	x	-	x	x	x	x	x
Conservation of Volume	x	x	x	x	x	x	-	x	x	x	x	x
Multiple Meaning of Words	-	-	x	x	x	x	-	-	-	x[1]	x[1]	x[1]
Definitions	x	x	x	x	x	x	-	-	-	x	x	x
Synonym Recall	x	x	x	x	x	x	-	-	-	x	x	x
Synonym Recognition	x	x	x	x	x	x	-	-	-	x	x	x
Sentence Completion	x	x	x	x	x	x	-	-	-	x	x	x
Similarities	x	x	x	x	x	x	-	-	-	x	x	x
Analogies	-	x	x	x	x	x	-	-	-	x	x	x

[1]Revised for deaf sample.

[1] Other tests administered are described in the section "Measures not Included in the Report."

The Examiners

A major problem throughout the study was the difficulty of obtaining qualified testers for the deaf. In general, persons skilled in psychological testing are trained only to work with the hearing, and few persons trained to work with the deaf have experience in and are available for the administration of psychological tests. The problem was most pronounced in the Piaget tasks. The only person located with skills both in communicating with the deaf and in using the clinical method developed by Piaget was a Swiss woman who, unfortunately, was not sufficiently fluent in English to test American children.

All potential examiners were given specific training, practice, and supervision in practice testing; they participated in conferences and discussions with persons working with the deaf and observed them at work; and assignments for specific testing were carefully made on the basis of individual qualifications. This was a time-consuming and expensive aspect of the study but was necessary to obtain as dependable an evaluation of the deaf as possibl.

The one person[2] on the research staff with more than the one or two full years of training cited by Piaget (1951, p. 2) as necessary for proper use of his clinical method used her knowledge and experience in training other examiners. The project director who, since the 1930's had had some training and experience with deaf children, and who was acquainted with the rationale of the clinical method of Piaget, administered the conservation tasks to the deaf. Another examiner[3] who carried a major responsibility for admimistering other tests to the deaf, took special classes in the education of the deaf at the University of Minnesota.

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[2] Dr. Lydia Muller-Willis, Ph.D., L'Institut des Sciences de L'Education, Universite de Geneve.

[3] Mrs. Susan Carlson Kisrow

Administration of the Measures

Both in planning the testing procedures to be used and throughout the testing sessions, the teachers of the deaf in the participating schools were most cooperative and extremely helpful. They made many valuable contributions through observing and criticizing practice-testing procedures and in suggesting the use of better techniques.

It was considered to be of primary importance, in the testing of the deaf, that the examiners have confidence that the subjects understood what was expected of them. This meant that some teaching techniques were occasionally used so that the examiner was certain that if a child responded inappropriately it was because he was unable to do otherwise and not because he did not understand the task. Insofar as possible, communication with the deaf was carried on through whatever channel(s) possible to maximize the child's responsiveness. Thus, lipreading, writing, and manual signs were used by the examiner, depending upon the particular child being tested. In all instances, however, an attempt was made to follow as closely as possible the procedures used with the hearing. Thus, for the most part, the verbal instructions compiled for the hearing were first read to the deaf subjects in order to provide them with the opportunity of understanding the task through the medium of lip reading. If the subject's response was not appropriate, several variations of the verbal instructions were tried. Since some words and phrases were more visible than others, common words, phrases, and sentences likely to be more easily lip read were identified for use. Pantomimed explanatory gestures and some signs were also used. For the older deaf, instructions were written when deemed necessary or desirable. In those tests in which writing was essential, written information was given the child at the initiation of the test situation to prevent writ-

ing from becoming associated with a preceding failure in oral communication. Deaf children have so much experience in imitative situations that when nonimitative responses were sought special care was exercised not to reinforce mere imitations of the experimenter. Throughout the testing of the deaf, care was consciously exercised to make certain that performance was based on the understanding of the task, and every possible effort was made to obtain the most valid responses.

For the most part, the battery of measures used in the investigation was administered individually to both hearing and deaf subjects. Only on the Moran, Watts, and Raven's tests were the older children tested in small groups and instructed to write their own answers. Sufficient individual attention was given in this small-group testing, however, to make certain that the procedures were understood by each subject.

The total number of hours devoted to testing each subject added up to a substantial amount of time, although the number of hours varied with age and hearing categories and with the specific test given. The time spent testing both hearing and deaf subjects in the first session averaged between five and seven hours per child. During the second session, testing time was approximately three to five hours per child. The time required for testing the deaf subjects was approximately the same as that for the hearing, but less information was obtained and fewer tests were administered in a single testing session. The total testing time required for the individual younger and older subjects was similar, although some of the testing time for the older subjects was spent in small groups.

All Piaget testing situations were tape recorded. Typescripts were made of the recordings of the sessions with the hearing subjects and

were used as protocols for scoring their performances. The recordings of the sessions with the deaf were not typed, since verbalizations were infrequent and most questions and answers were written, but the experimenters' taped interpretations of the gestures used by the children were coordinated with the written material in scoring the performance of the deaf children. On some of the conservation of number, substance, weight and volume tasks, an observer, in addition to the examiner, was present in the testing situation.

At each of the sessions, measures were administered to both hearing and deaf children by several different examiners, but the same examiners tended to administer the same tests. Except for the individual Moran tests, the order of the measures was not controlled. The Moran Tests had no particular place in the total test battery, but were themselves always given in the same order: Definition, Synonym Recall, Synonym Recognition, Sentence Construction, Similarities, and Analogies.

The inevitable deviation in the administration of the tests to the deaf was a study variable that could not be controlled. Its effects on the results cannot be estimated or measured. There is no question that if the deaf sample had been restricted to subjects with the same lip-reading and/or oral facility, the tests could have been administered with less variability to each subject. To secure such a homogeneous sample, however, it would have been necessary to draw from a population far larger than that existing in the available geographical area. Oral facility is a function of age, training, and other variables, the control of which were not within the scope of this study. The purposes of this study were served best by communicating the tasks to the deaf subjects in whatever way possible. Deviation in specific aspects of test

administration is unquestionably a variable in all studies involving deaf subjects, and must be considered, therefore, as an uncontrolled, environmental factor.

Nonlanguage Measures

The tests included as nonlanguage measures were (1) Raven's Progressive Matrices Test, (2) Weigl-Goldstein Scheerer Color Form Sorting Test and (3) Gelb-Goldstein Color Sorting Test. The Farnsworth Dichotomous Test for Color Blindness was used merely to ascertain the color vision of the subjects taking the sorting tests.

Raven's Progressive Matrices Test

Raven's Progressive Matrices Test is a well known standard measure. It is based on the principle of visual perception and designed to measure a subject's ability to form comparisons and to reason by analogy. The problems are large figure illustrations with one part missing, and eight multiple choices from which the subject may select the suitable part. The Standard Progressive Matrices were used in conjunction with the Coloured Progressive Matrices. Part I (sets A, A_B, B) (Ravens, 1956) only were administered to D(1) at both testing sessions. For all other groups, Part I (sets A, A_B, C) was followed without interruption by Part II (sets C, D, E). The test was administered individually or in small groups to both deaf and hearing: verbally to the hearing and in pantomime to the deaf. Care was exercised to make certain that the deaf understood the requirements of the task before starting.

The scoring procedure used was the author's, although raw scores were used in the analyses of the data presented here. The maximum raw score is 12 for each set. Thus, the maximum score is 36 for Part I (sets A, A_B, B) and 36 for Part II (sets C, D, E), with a total maximum score of 72.

Sorting Tests

The sorting tests were taken from a battery of measures devised by Goldstein and Scheerer (1941) and their colleagues to differentiate between abstract and concrete behavior (Goldstein and Scheerer, 1941, pp. 1-4). Although the original purpose of their battery was to assess brain-injured patients, two of the tests were included in this study because the differentiation of abstract and concrete performance was an appropriate dimension on which to compare hearing and deaf subjects. The tests[4] used in the present study were the Weigl-Goldstein-Scheerer Color Sorting Test (Goldstein and Scheerer, 1941, pp. 110-130) and the Gelb-Goldstein Color Sorting Test (ibid., pp. 58-80).

For both tests the materials, procedures of administration and scoring described by the authors were followed as nearly as possible for both deaf and hearing, except that written instructions were used with the deaf when necessary.

Before the sorting tests were administered, the Farnsworth Dichotomous Test for Color Blindness was given to all subjects. Three subjects were found to have some aberration in color perception -- one girl and one boy in the H(3) and one boy in the D(2) age groups. Since the performance of these subjects on the sorting tests did not deviate from that of others in their age groups, they were not eliminated from the analyses.

Weigl-Goldstein-Scheerer Color Form Sorting Test.

Purpose. This test was designed to determine whether in sorting a variety of differently colored figures, the subject is able to shift the category of sorting from form to color, or vice versa.

Materials. The standard 12 figures -- four each of equilateral

[4] Record Forms published by the Psychological Corporation.

triangles, squares, and circles, one red, one green, one yellow, and one blue in each set -- were used. The reverse sides of the figures were white.

Administrations. According to the authors' procedures, the 12 figures were placed randomly before the subject and he was asked to group the figures that belonged together (Experiment I, Sorting).[5] After the task was completed, he was asked to sort the figures again "in a different way" (Experiment II, Voluntary Shifting). If the child did not shift the dimension of grouping voluntarily, he was presented with a number of maneuvers by the experimenter that were designed to induce the shift (Experiment III a-d, Induced Shifting).

Scoring. If the child shifted the dimension of grouping either voluntarily or after inducement, his performance on the test as a whole was classified as Abstract, and if he did not shift, as Concrete. Since the deaf, for the most part, were unable to account verbally for the principle of their sortings, verbalization was not considered in the classification of the performance of either the deaf or the hearing. Spontaneity of shift was not considered in the classification of performance, but it was in the description of performance.

Gelb-Goldstein Color Sorting Test.

Purpose. To determine whether a subject could sort a variety of colors according to definite concepts, and within the approaches needed in the tasks.

Description. The standard Holmgren set of 61 colored skeins of yarn was used and the authors' instructions were followed in the administration of the four experiments making up the test. In two experiments (I and III) the subjects sorted to a given color: (1) To a sam-

[5] See Record Form published by The Psychological Corporation, for Experiments.

ple skein of yarn selected by the child and to a sample skein selected by the examiner, and (2) To verbalized color names -- green, red, and blue. In Experiments IIA, IIB, and IV, the child's preference for matching yarns on the dimension of hue or of brightness, and his ability to shift the dimension of matching, was measured using three colors and a substantial number of skeins of yarn.

Scoring. The performance on the test as a whole and for each experiment was classified as Concrete or Abstract.

Quantitative scores were obtained for the two types of experiments by summing the number of Abstract or Concrete classifications on the items. Thus, the maximum quantitative Abstract or Concrete Score for the sorting experiments (I and III) was 5, that for the hue and/or brightness matching experiments (IIA, IIB, and IV), 11.

Although these scores are not all consonant with the rationale of Goldstein and Scheerer, they were used in order to take account of the different performances on different parts of the test. They were not considered to replace the classification of performance on the test as a whole.

Conservation Tasks

The concept of conservation is concerned with the invariant nature of properties of materials (e.g. amount, weight, or volume) despite various transformations of the materials, (e.g. changes in shape, position or containers). In the present study the conservation of number, substance, weight and volume were assessed. These conservation tasks have been frequently described in the literature (e.g. number: Piaget, 1952, pages 25-38; 1950, pages 129-132; substance, weight, and volume: Piaget and Inhelder, 1951, pages 6-79; Piaget, 1950, pages 146-147), and have been used by a number of investigators (Dodwell, 1960, 1961; Elkind, 1961a, 1961b, 1961c;

Lovell and Ogilvie, 1960, 1961; Smedslund, 1961).

Concentrated efforts were made to follow the clinical method of Piaget in obtaining responses from the subjects, and to systematize the testing procedures within this framework. Each transformation for the number, substance and weight tasks was predetermined and presented in as constant an order, and as similar a manner, as possible. The essential aspects of the procedure with each transformation were a demonstration for the subject by the examiner, a prediction elicited from the subject, a demonstrated verification, and an explanation of the prediction and/or verification elicited from the subject. As much systematization was introduced in the materials and the precedures used in the testing session as was consonant with maintaining the use of the clinical method.

Classification and quantitative scores were used in this report primarily for the information they supplied on the level of subjects' performances rather than in relation to the theories and research of Piaget. A classification score was determined by assigning the child's performance into a stage in the development of the concept of conservation identified according to Piaget (1950, 1952) and Piaget and Inhelder (1941) as follows:

Stage I -- No conservation.

Stage II -- Conflicting conservation and nonconservation responses.

Stage III -- Conservation stable and accepted with logical certainty.

For the hearing subjects, typescripts of each task were used in assigning a child's performance to a Piaget stage. A person other than the scorer first cleared the typescripts of all subject identification and arranged them according to the first initial of the last name in varying patterns for the several tasks. All performances on each task were classified separately; consequently a child's performance on one

conservation task (number, substance, weight, or volume) could not influence the evaluation of his performance on another task.

For the deaf, however, since classification was based on both tape recordings and written material, each child's performance on all the conservation tasks was classified successively. The child was not identified to the scorer however, and special care was taken to classify the performances on the separate tasks as objectively as possible.

Quantitative scores were based on the rationale that each transformation is an item testing the subject's understanding of the concept of conservation in a particular task. Thus the sum of the number of conservation responses were used as a quantitative conservation score for that particluar task.

In determining the quantitative conservation score, the subject's relevant prediction, verification (if applicable), and explanatory behavior for each transformation was first transferred to the semi-objective scoring sheet devised for each task (see Appendix B). For the hearing children information was transferred to the scoring sheet from the first-session typescripts and from the second-session recordings; and for the deaf children from the tapes and the written responses for both sessions. Before any scoring was done, however, identifying data on the subjects were deleted, and sheets were grouped by tasks. The scorer did know whether the scoring sheets were of deaf or hearing subjects.

For each item (transformation) on each task, the presence or absence of adequate understanding of conservation was recorded. A conservation response was defined as both a correct prediction and the understanding of the identity of the material, after each transformation. Thus, the conservation score was determined by the number of check marks

in the "Identity" column on the scoring sheets. When fewer or more transformations had been presented to a subject, the conservation score was calculated on the basis of the number of "items" or transformations expected to have been presented for each task.

In testing the deaf children, both the use of the clinical method and the attempts at systematization of the test procedures could not be so rigidly adherred to. Since most of the deaf children in this study were not highly oral, writing and occasionally signs were necessary to communicate with the children. Throughout the tape recordings of the sessions the project director (who interviewed all deaf subjects on these tasks) explained what was being done, noted explanatory gestures, and then interpreted oral utterances of the children that would have been difficult to understand out of the context of the test situation. It was sometimes necessary to vary the order of, repeat, or introduce a different, transformation in order to evaluate more certainly the responses of the deaf children. Any modification of the prescribed procedure was introduced to make more satisfactory the evaluation of the performance of the deaf subjects.

<u>Conservation of Number</u>

<u>Materials</u>. Seven 1" red and 7 1" green wooden cubes with a hole that could be used as beads or blocks, two glass jars (2" and 8"), and one glass jar (4" x 4") consistently, and shoe laces occasionally, were used.

<u>Administration</u>. The examiner placed before the child 7 cubes of one color and kept the other 7 before herself. Before any transformations were begun, she elicited from the child agreement on the number of red and green cubes. When this was accomplished, the examiner introduced the first transformation by placing the two tall jars between the

child and herself and asking the child to predict, "If I put my beads (or blocks) in this jar (pointing to one) and you put your beads (or blocks) in this jar (pointing to the other) will there be the same number of beads in each, or will one have more, or less?" Whatever the prediction given by the subject, the examiner then asked him to put the cubes of one color in one jar. As the subject dropped them in one by one, the examiner simultaneously dropped a cube of the other color in the second jar. When seven cubes were in each jar, the subject was asked to verify his prediction. "Are there (the same number, more or less, whatever the child had predicted) beads (or blocks) in each jar?" After the child responded, he was asked to explain his response and/or what he had observed.

This general procedure was usually observed with the following four transformations of beads:

1. 7 beads placed in each of two tall jars (described above).
2. 7 beads from one tall jar transferred to a low jar.
3. 7 beads placed in an extended line; 7 in a compressed line.
4. 7 beads in a spread group, 7 in a compact group.

In a few instances additional transformations, particularly the stringing of 7 beads into a "long" necklace, and of 7 beads into a "short" necklace, were introduced. More frequently, however, particularly with the older subjects, not all the transformations were used if the conservation of number was firmly understood and continued presentation of the transformations might reduce the likelihood of cooperation for the ensuing conservation tasks.

Scoring. Protocols were assigned to Piaget Stages I, II, or III as described. The maximum quantitative score used was 4 since the four transformations were the only ones presented with consistency. For this

task, the use of a quantitative score is probably questionable, since the transformations were less consistently presented, than for the conservation of substance and weight tasks.

Modifications for the deaf. An attempt was made with the deaf subjects to carry on the administration and scoring procedures as nearly similarly as possible as with the hearing subjects.

Conservation of Substance

Materials. Two one ounce balls of plasticene, one yellow and one terra cotta were used.

Administration. The equality of the quantity of substance in the two balls was first established with the subject. If the subject did not initially agree that the balls had the same amount of matter, tiny additions or subtractions of plasticene were made until he agreed that the balls were the same in mass. After this agreement (and only after the subject had affirmed that the two balls were exactly the same or alike), five transformations were made:

1. One ball left intact, the other transformed into a 3" disc.
2. One ball, the other transformed into one sausage approximately 4" long.
3. One ball, the other broken into two pieces.
4. One ball, the other broken into four pieces.
5. One ball, the other broken into eight pieces.

The following question, not demonstrated, was asked: "If I broke the clay into 100 pieces would there be the same amount of clay, or would there be more clay, or less clay?"

For each transformation the prediction of same, more, or less was elicited from the subject. There was no verification, but an explanation was obtained for each response. No balance was used, and the sub-

ject was not given the plasticene to hold.

Scoring. Protocols were assigned to Piaget Stages I, II, or III. A Conservation Score for Substance was obtained by summing the number of conservation responses, or, if all transformations had not been presented, by converting the number of conservation responses to a base of 6 which was the maximum conservation score for substance.

Modifications for the deaf. No modifications were systematically used for the deaf subjects, but additional and varied attempts were introduced to maximize the certainty that the subjects' performances were evaluated correctly.

Conservation of Weight

Materials and Administration. The materials and the transformations were essentially the same as for the conservation of substance, except that the subjects were encouraged to hold the plasticene in their hands or to use the balance that was in view on the testing table. The equality of the weight was demonstrated by balancing the two balls of plasticene in the hands of the examiner and the subject and was then illustrated on the balance. The balance was also used to verify the predictions.

Scoring. The protocols were assigned Piaget Stages I, II, or III. The conservation of weight score was the sum of the number of conservation responses, with a maximum of 6.

Modifications for the deaf. No modifications were systematically made.

Conservation of Volume

Materials. Two one-ounce balls of yellow and terra cotta plasticene; two 2" x 8" jars (previously used in the conservation of number task); and rubber bands of different colors were used.

Administration. After the equality of the two one-ounce balls of clay was verified, the two tall jars were filled with water to the same level. Agreement was elicited from the subject that the water in the two jars was at the same level, and he was asked to mark this level with rubber bands of the same color before the demonstration was continued. The explanation of the understanding of the conservation of volume was based on the displacement of the water in the two jars. The child was asked to predict what would happen to the level of water in one jar if a ball of plasticene was placed into it. If his prediction included a change in water level, he was asked to mark the predicted level with a rubber band of a different color before the ball was placed in the water. Whether or not a rise in the water level was predicted, the ball was put into the jar, the accuracy of the prediction noted, and the subject asked to explain the observed rise in the level of the water. Exploration of the understanding of the conservation of volume was continued until the examiner was certain that the subject either did or did not understand it. Predictions and explanations were also sought under some of the following conditions: (1) Placing the second ball of plasticene into the second jar, (2) using one ball as such, the other transformed into a sausage, (3) using one ball as such, the other transformed into two pieces, (4) using one ball as such, the other transformed into four pieces, (5) using one ball as such, the other transformed into eight pieces.

Scoring. The protocols were classified into Piaget Stages I, II, and III. No quantitative score was determined for the conservation of volume task since it was necessary to explore the child's understanding of it with less systematization than was done in the other conservation tasks.

Modification for the deaf. In order that the examiner might be more certain of the evaluation that the concept of conservation of volume was or was not understood, additional transformations using plasticene cubes the same size as the wooden cubes were used, in a few instances.

Vocabulary Measures

From the possible areas of language behavior, that of vocabulary was selected for this investigation. The measures selected were designed to assess the subjects' understanding and usage of certain common words rather than the size or characteristics of their vocabularies of either use or recognition. A count of words recognized and used by subjects assesses the extent of the particular kind of vocabulary measured. The knowledge of different meanings of the same word, or the ability to use the same meaning of a word under a variety of different conditions, gives a measure of the depth and breadth of understanding that involves a different dimension of vocabulary. Such measures based on the work of Watts (1944) and Moran (1953) were selected for use in the investigation reported here.

Watts' Multiple Meaning of Words Test

Watts, in his research on language and mental development of English children, devised a series of more than 20 tests to measure knowledge and usage of words in seven different language areas. From the eight measures in the vocabulary area, one, "Words with More than One Meaning" (Watts, 1944, pp. 283-84) was chosen for this study.

Purpose. The test was included in the battery because it measured the ability to use the same eight words in a variety of different contexts and as different parts of speech, but with different meanings. Rather than measuring the extent of vocabulary, the test measured the

depth of understanding of the eight selected words.

Description. As devised by Watts, the test had a multiple choice format in which each of eight words was used five times (with a different meaning for each usage), to complete 40 sentences. The words were cover, cross, head, line, point, roll, round, and run. All eight words are among the one thousand most commonly used, according to the Thorndike-Lorge Word List (1944) and all but cross and roll are among the 500 most commonly used. All the words are found in the vocabularies of primary school children, according to Murphy's (1957) count.

To use the test with American children it was necessary to replace certain of the original sentences because they were obvious Anglicisms and not familiar to the subjects in this study. Substitute sentences using the same words but in contexts more familiar to American children were inserted for items 5, 9, 21, 17, 31, and 37 using the same numbers in the test. In other of the original sentences, single, specific words were changes, e.g. pounds was changed to dollars, Aberdeen to Scottish, horsemen to cowboys. The general format of the test was retained. The modified Watts test appears in Appendix B.

Administration. The measure was administered to the children as a group test. At the beginning, the subjects were instructed by the examiner as follows: "Most words have more than one meaning. Think for example, of the word bridge: We may speak about a bridge over a river and also about the bridge of the nose (quite another kind of bridge); we may speak, too, of the bridge of a violin (still another kind of bridge) and of the game of bridge (which again, is quite another kind of bridge). Here are eight more words which have more than one meaning...." After the words were read, the subjects were told, "These eight words may be used to fill in the sentences below. See if you can

put them in the right places. You will find when you have done this that you have used each of the eight words five times."

Scoring. The score was the number of sentences completed correctly, and 40 was the maximum. Subscores were obtained to indicate the number of correct usages for each of the eight test words.

Modifications for the deaf. Because the version of the Watts Multiple Meaning of Words Test given to the hearing subjects was found to be too difficult for the deaf subjects, a modification of the measure was devised for administration to the deaf. The modified test was made up of 15 sentences in which each of five of the original eight words -- cover, cross, head, point, roll -- was used with three different meanings. The choice of items for the modified test was made on the basis of correct usage of words and correct completion of sentences by the H(21) and H(31) groups. The five words selected were those supplied correctly by more than 50 per cent of the subjects in the two age groups. The sentences selected for the modification were those that 75 per cent or more of the subjects in the two hearing age groups were able to complete correctly.

The modified test for the deaf (see Appendix B) was administered to the D(22), D(31), and D(32) subjects in small groups of two or three children. The test was too difficult for the D(21) group. The subjects wrote their answers directly on the form provided. The same instructions used with the hearing subjects were placed at the top of the test form and were read by the examiner together with the subjects. As soon as it was ascertained that a subject had grasped the idea that a word had more than one meaning, he was permitted to proceed through the test at his own rate. The test was not timed, but about 20 minutes was necessary for completion.

The maximum score for the deaf was 15 since one point was given for each correct response. Subscores of the number of correct responses for each of the five test words were also obtained. Percentage of correct responses was used for comparison with hearing subjects.

Moran Word Tests

For a study of matched pairs of schizophrenic and nonpsychiatric patients, Moran (1953) designed a battery of seven tests in which the subjects' depth of understanding of 25 commonly used words was explored. In most studies of vocabulary, a word is assumed to be known when it is defined, used in a sentence, or identified in some way. Moran, however, constructed his battery of tests on the belief that the understanding of a word could be best determined by ascertaining a subject's knowledge and use of the word in different contexts.

Six of the seven tests are included in this report, the three measuring understanding of the word and the three measuring ability to use the word. The tests of understanding are, (1) word definitions, (2) synonym recall, and (3) synonym recognition; the tests of use are (1) sentence construction, (2) similarities, and (3) analogies.

The following 25 words form the basic list used by Moran in the seven tests: 10 thing referent words: house, clock, clothes, car, dirt, boat, door, food, street, garbage; and 15 nonthing referent words: friend, big, faith, command, new, add, danger, all, strong, death, God, wise, hate, enemy, master. This basic list is used in subjective items in the Definitions, Synonym Recall, and Sentence Construction Tests, and in objective items in the Synonym Recognition, Similarities, and Analogies Tests. The Sentence Construction Test and the three objective tests are presented in Appendix B.

On the Thorndike-Lorge (1944), Murphy (1957), and Rinsland (1945) lists there is agreement that all except four words are common for young children. Of these, dirt and garbage are listed as common on two of the three lists, and would seem, empirically, to be familiar words. Faith and command, however, are not as relevant to young children's interest and may not appear in their conversations. Nevertheless, these words are listed no higher than the third grade on all three lists checked. It should be noted too, that there is ample evidence that the meanings are understood of far more words than are used by both children and adults. From this overall evaluation of the 25 words used in the Moran tests it was decided that they were common enough words for most children and that they were suitable for presentation to the subjects in the study reported here.

Although no references in the literature indicate that the Moran tests have been used with children, they were selected for this study because of their intensive exploration of the knowledge and use of specific common words within different contexts. The tests were presented to the subjects in the following order: Definitions, Synonym Recall, Synonym Recognition, Sentence Construction, Similarity, and Analogy. This sequence was determined to minimize the influence of each test upon the subsequent ones. Subjects were asked to define the words before using them. Recall of synonyms was obtained before recognition of synonyms so that the words presented in the latter test would not influence responses on the recall task. The order of the last three tests was somewhat arbitrarily decided upon to represent a progression from the more to the less familiar in tasks associated with the use of the test words. With the exception of the placement of the synonym recognition test, the order of presentation is the same as that of Moran.

In introducing the battery of Moran tests to the subject, the examiner said, "We are going to do a lot of different things with some words. You will be surprised how many things you can do with the same words." For each specific test, examiners concentrated on making certain that the subjects understood the nature of each task. Several examples were given which the subjects were given the opportunity to work out, but the test words were never used illustratively. The examiner indicated the correct answers to all illustrations before proceeding to the test words. In the test situation itself, the examiner encouraged the subject to keep trying and praised his efforts.

In order to classify the children's responses as meaningfully as possible, a detailed elaboration of the categories of response used by Moran, and changes in some of the categories themselves, were necessary. Analyses based on the classification of responses are, for the most part, not included in this report but will be published later.

As far as possible, the quantitative scoring system devised by Moran was used in the study reported here. The scoring for the objective tests was not modified except that responses to the stimulus word God were included in determining scores. Moran did not include the responses to the stimulus word God since it elicited a wide variety of esoteric responses, i.e., synonyms for the word God that are apparently used by some little known religious sects. Such responses were not made by the subjects in this study. Some modification of the classification scoring was considered essential when fundamental differences appeared between the responses of adults and children. The classification systems used in determining the quantitative scores are presented in Appendix B.

Word Definition Test

Purpose. The test measured the ability to express what the sub-

ject understood to be the meaning of the test words.

Description. Moran's basic list of 25 words, listed previously, were presented in the order of Thing and Nonthing.

Administration. The test was administered orally to the H(1) and H(2) groups. The examiner introduced it by saying, "Here are some words. I want to find out what you think they mean. For example tell me what chair is." The examiner varied the instructions in order to obtain the subject's best definition of the word, by using such phrases as, "What does --- mean?" "Tell me what --- is." "Just tell me in your own words, I only want to find out what --- is." The subject was questioned further if the stimulus word or a variation of it was used in the definition. If the definition seemed to indicate a misunderstanding of the word, e.g., "beg" for "big" or "deaf" for "death," the child was further questioned. The examiner wrote down everything the child said that was pertinent to the definition. A similar procedure was followed in introducing the task to the H(3) group but, for the most part, the children wrote their own definitions directly on the test forms.

Administration to the deaf. The D(22), D(31), and D(32) groups wrote their answers directly on the test forms. In presenting the task, the examiner conveyed the idea of the subjects' defining the word orally and/or through prepared written instructions, similar to the instructions presented orally to the hearing groups. After it was determined that the deaf subjects understood what was wanted of them, they were given the following typewritten instructions: "Write so we know what you think the word means. Write the meaning--short or long--just so we know what the word means." As with the hearing subjects, the deaf were questioned during the testing procedure to assure the examiner that the subject's best response was available for evaluation.

Scoring. The subjects' responses were categorized as follows: (-) An incorrect definition; (½+) a definition indicating partial conceptualization of the word meaning; (+) a definition indicating clear and specific understanding of the stimulus word. These categories are described more fully in Appendix B.

Three quantitative scores were obtained from these categories. The sum of the responses in each category was its score, the possible maximum in each category was 25 for the Total test, 10 for the thing referent words, and 15 for the nonthing referent words.

Moran Synonym Recall Test

Purpose. The purpose of the test was to obtain from each subject as many synonyms as possible for each stimulus word. Moran (1953, p. 9) stated that a subject was, in effect, "being asked to define the word many times. His 'definitions' furnish an indication for the conciseness of his concept of what the word symbolizes. He must select from numerous associations only those words that symbolize an identical concept; related but nonsynonymous words must be discarded." Thus, the test "measures the subject's active understanding of the breadth and preciseness of the meaning of the word" (underlining added).

Description. The test consisted of the basic list of referent words presented in the same sequence as in the Word Definitions Test.

Administration. In administering the test to the hearing subjects, the examiner said, "Some words mean just about the same thing as other words, don't they? For example, if I said little, we would think of small, tiny, teeny-weeny, itsy-bitsy." The subject was encouraged to give as many of these synonyms as he could. Sometimes to make certain that the subject clearly understood the idea of synonyms the stimulus word cat (with suggested synonyms of pussy, kitty, and kitten) and

pretty (with synonyms of beautiful and lovely) were also used. Then the examiner continued, "Now I will tell you a word and you tell me as many words as you can that mean the same thing." The examiner recorded the responses of the younger groups, but the older children wrote their own responses on the test form.

Modifications for the deaf. The instructions were given to the deaf subjects orally and in writing. The examiners used more illustrations with them than with the hearing subjects. After the examiner felt that a deaf subject understood the task, he was read, and then presented with, the following instructions typed on a card, "Write as many words as you can think of that mean the same as each word listed. If you can't think of any word that means the same as a word listed, then go on to the next one. Try each word."

Scoring. Three scores were obtained for the 10 thing-referent words, the 15 nonthing-referent words and the total list, according to the following categories; (1) total number of words given as responses, (2) total number of correct synonyms, and (3) ratio of number of synonyms to total number of responses, expressed as a percentage. No predetermined maximum was set for the first two scores. The ratio varied from 0 to 100.

Although responses were categorized according to their relation to the stimulus word, an analysis of these categories is not included in this report.

Moran Synonym Recognition Test

Purpose. The test measured the subject's ability to select from a given number of words those that were synonymous with the stimulus word, and to ignore those that were not. The task, therefore, actually was one of recognizing the boundaries of a concept; unlike the synonym re-

call test, it did not measure the private meanings of words. In contrast to the synonym recall test, the synonym recognition test was a measure of the subject's passive understanding of the breadth and preciseness of the meaning of the word, and it was anticipated that the scores would be higher than on the synonym recall test.

Description. The test was multiple choice, constructed around the basic list of thing and nonthing referent words. After each word, eight word choices were presented of which from two to five were correct synonyms. The incorrect alternatives were either neologisms or words that bore some relation to the stimulus word but were not acceptable synonyms. For example, for the stimulus word street an offered neologism was alevard, and an associated nonsynonym, traffic. The test appears in Appendix B.

Administration. A practice item was used to introduce the task to the subjects. The examiner said, "I am going to tell you a lot of different words. Then I want you to tell me which mean the same as the first word I say. For example, here are some words: cat, milk, kitten, tail, pussy, fur." The subjects were then asked, "Does milk mean the same as cat? Does kitten mean the same as cat? Does tail mean the same as cat?" A decision on whether each word was or was not a synonym for cat was obtained from the subject and any word correctly identified as a synonym was underlined. For the younger hearing subjects, each word was read aloud and referred to the stimulus word with the question, "Does --- mean the same as ---?" For the older subjects, after the idea of identifying the synonyms was established, each word was read aloud or pointed to by the examiner, or read aloud by the child, and the examiner underlined the correctly identified synonyms. The oldest hearing subjects by themselves read the words silently and underlined those

they believed to be synonyms.

Modification for the deaf. The procedure for the deaf was essentially the same as that for the young hearing group except that more time was spent in giving each subject sufficient additional illustrations to be certain that he understood the task and knew that in any one line no particular number of words were supposed to be underlined. As with all testing of the deaf, instructions were given verbally and by gestures, signs, and pantomime, as they were deemed necessary.

Scoring. The following scores were obtained for the thing and nonthing referent words and for the total words: (1) Number of synonyms identified, (2) Number of nonsynonyms identified, (3) Number of neologisms identified, (4) Percentage of synonyms of total words selected, and (5) Percentage of neologisms of total words selected. The maximum possible for the first three scores were, for thing items, 35, 40, and 5, respectively; for nonthing items, 60, 52, and 8, respectively; and for the total score, 95, 92, and 13. The ratios varied from 0-100. Although Moran did not include the responses to the stimulus word God in his scoring, they are included in this report.

Moran Sentence Construction Test

Purpose. The test measured a subject's ability to integrate one to three words in the construction of a meaningful English sentence. Thus, the subject's ability to conceptualize the arbitrarily presented words in appropriate contexts was investigated.

Description. The test consisted of the basic 25 words presented singly, in pairs, or in groups of three, for use in the construction of 12 sentences. The task was ordered in increasing difficulty according to the number of words to be used in a single sentence. Of the 12 sentences, two were to be formed incorporating single words; seven, incor-

porating two words; and three, incorporating three words. The test appears in Appendix B.

Administration. The following instructions were given to each subject, orally to the younger ones, in written form and read with the older ones: "I am going to give you a word or two and I want you to use the words in a sentence. For example, cat. How could we use cat? The cat is playing with the ball. The cat is drinking milk." Examples were also obtained from the child. "Another example is doll and tree. Both words must be used in the same sentence." The example presented the child was, "Jenny played with her doll under the tree," and the subject was encouraged to give an example. The stimulus words were presented until the subject was unable to form an adequate sentence after several trials, and the test was halted before all stimuli were presented only if there was positive indication that the subject was unable to perform the task.

Modifications for the deaf. The procedure with the deaf was similar to that for the hearing, but special care was taken to emphasize that all words presented together were to be used in a single sentence. The examiner said, for example, "If there are two words, both of them must be used in one sentence. Here are dog and cat. We could use them in one sentence like, 'I have both a dog and a cat at home as pets.'"

Scoring. A sentence was classified as adequate or inadequate. An adequate sentence was meaningful, grammatically acceptable, and the stimulus words in it were used correctly. Sentences were considered grammatically acceptable, however, if they contained minor grammatical inaccuracies. When more than one stimulus word was presented for use in constructing a sentence, the subject was not required to use the words in the same order that they were presented to him. A sentence was

also considered adequate if the stimulus word(s) were changed in number, case, and tense, or were compounded.

A sentence was categorized as inadequate if it (1) was grammatically acceptable but did not use the stimulus words; (2) was grammatically unacceptable, i.e., had major grammatical inaccuracies; and (3) if it was grammatically correct but expressed an essentially illogical and/ or absurd idea, e.g., using the stimulus words clock and garbage in the following absurd sentence: "I put the garbage in the clock." A more detailed breakdown of the categories is presented in Appendix B.

The only quantitative score in the test was the number of adequate sentences constructed. No distinction was made in the use of thing and nonthing referent words. The maximum score was 12.

Moran Similarities Test

Purpose. In this task, the subject was required to verbalize the conceptual relation of a given number of words. It measured his ability to extract concepts from words and the levels of his conceptual formation.

Description. The test was composed of 17 groups containing two to four words each, of which 21 words were not in the basic list. Each group of words was to be categorized by a single concept.

The first seven groups were comprised of thing-referent words; the remaining 10 groups, of nonthing-referent words. The test is presented in Appendix B.

Administration. The subjects were given illustrative explanations, such as, "I am going to tell you a couple of words. I would like you to tell me in what way they are alike. In what way are cat and dog alike?" The groups of test stimulus words were presented in order until the subject made three consecutive failures. When this occurred, item 12, How are master and boss alike? was presented as the final item.

Modifications for the deaf. In administering this test to the deaf, the word same was always used in addition to alike. The word same is more likely to be in the vocabulary of deaf children and the sign for same was commonly used or known by many of the deaf subjects in the study.

Scoring. Responses were scored as "abstract," "adequate," or "incorrect." An abstract response was one in which the words were grouped in an appropriate category; an adequate response, one in which the words were not categorized but a meaningful similarity among them described; an incorrect response was one in which neither an appropriate category nor a meaningful similarity was related to the group of words. Thus, if the stimulus words clock and ruler were grouped together under the generic concept of measurement, in such phrases as "for measuring," "to measure with," etc., the response was scored as abstract. On the other hand, if a descriptive similarity, such as "they both have numbers on them," was given for the two words, the response was scored as adequate. The scoring terms are taken from Moran.

The thing-referent items and the nonthing-referent items were scored separately. Maximum abstract, adequate and incorrect scores for the thing items were 7; for the nonthing items 10; and for the total score 17.

Moran Analogies Test

Purpose. The test measured the ability to reason by analogy. Moran (1953) considered the test one in which, "The subject is asked to abstract a general principle from the relationship of two words and to find another group of two words that have an identical relationship to each other" (p. 14). He termed it a test of symbolic reasoning with words.

Description. The test consisted of 11 analogies incorporating all the words on the basic word list and many more. Each analogy followed the pattern,

BOAT is to WATER, as CAR is to FLOAT, LAND, WHEELS, RIDE.

Three practice items were given. The entire test appears in Appendix B.

Administration. The subject was told, "I will tell you two words which fit together in some way. Then I will give you another word, and after that some more. Now you are to tell me which word fits the third word the same way that the first two words fit. Let's look at ---," and the three examples were shown. The examples were analyzed several times for the younger subjects, and attempts were made to group words visually for them by encircling words, pointing to those that had agreed relations, etc. The examples were given to the H(11) group, but not a sufficient number were able to understand the task and their tests were not scored. All items were given to all other hearing groups.

Modifications for the deaf. In the attempt to increase the likelihood of the understanding of the task by the deaf subjects, additional examples were made up and used as a teaching device, as, for example,

MOTHER is to BABY, as DOG is to KITTY, MAN, PUPPY, TREE.

Encircling the first pair of words, putting a half bracket around the third word and then encouraging the subject to complete the task by bracketing the correct word, and the use of gestures, are examples of the techniques by which attempts were made to increase the deaf subjects' understanding of the test.

Scoring. One point was given for each correct analogy. No distinction was made between the items containing thing-referent and non-thing-referent words. The maximum score was 11.

Measures Not Included in the Report

During the course of the study a number of measures that are not included in the analyses presented in this report were obtained. Of these, four assess the understanding of a previously known word or concept in a controlled testing situation; one assesses the acquisition of the meaning of a "nonsense word" in a controlled testing situation; one recorded the procedure subjects followed in drawing a man or the self; one used the Moran Word Test in a Word Association test; one assessed ability to discover and formulate a principle. The measures were included in the original testing design since they provide information on cognitive performance important within the framework of the objectives of the study. They were eliminated from the report because the results could not be used in the comparisons. All measures except one were not administered to both hearing and deaf samples.

Since measures eliminated are not standard tests or well known research instruments, each is briefly described here. Analyses on some of these measures have been completed.

(1) Sentence Completion Test. This test was administered to the H(21), H(22), H(31), and H(32) groups. It is a 35-item sentence completion test adapted from Watts (1944) in which blanks in sentences are to be filled in with prepositions. The test was revised into a modified multiple choice format that was administered to the H(22) and H(32) groups. The tests were too difficult for the deaf subjects.

(2) "If" Test. This test was devised for the study but was administered only to H(11), H(21), and H(31) subjects. It consisted of five items designed to assess whether or not subjects understood the concept

of conditionality as determined by the use of the word "if" in different contexts and situations.

(3) Counting and Relational Concepts. Utilizing the findings and techniques of Russell (1936), a test consisting of three parts was devised (a) to obtain information on the counting ability of subjects, and (b) to ascertain in standard situations the understanding of the terms same, equal, most, more, less, and least. The test was given only to the H(11) group. It was not given to the older hearing subjects since the counting aspect was too simple, and the time required was too great for the amount of information obtained on a subject's knowledge of relational words. The test was too difficult for the D(11) group, and much time was needed to elicit sparse information from the D(21) and the D(31) groups. The entire test was never given to deaf subjects, but with flexible procedures, the test materials were used to gain minimal information on the subject's counting ability and understanding of the relational words.

(4) The rule of signs. In a replication of a Swiss study by Muller (1956) (carried out under the direction of Piaget), four "experiments" were used to measure the understanding of algebraic signs. The procedures were duplicated and the original investigator administered the measures to the H(11), H(21), and H(31) groups in this study. The measure was not used with the deaf.

(5) Acquisition of Word Meaning. Werner and Kaplan (1950) developed a technique to assess ability to imply meanings to "nonsense words" each of which was imbedded in six sentences. Five of the 12 test words used by Werner and Kaplan were presented to the H(21) and H(31) groups. None of the deaf were tested.

(6) Draw-A-Man Process. This represents a preliminary attempt at

the development of a projective measure. While the subject drew a picture for the Goodenough Draw-A-Man test, the examiner recorded on a schematic human figure the point of initiation and termination of the drawing and the sequence of movements followed in the production of the drawing. The development of a projective device in which a system of reliable scoring is not only a major but an initial task is beyond the scope of this study. However, sufficient work has been done to indicate that reasonably reliable scores can be obtained on categories such as orientation toward the whole or to parts of the drawing, the cephalocaudal direction and the extent of use of alternation in the execution of the drawing. Although the procedure of drawing was recorded for all hearing and deaf groups at both testing sessions, the development of the scoring system has not progressed sufficiently to be used in the comparisons presented in this report.

(7) Moran Word Association Test. The 25 words in the Moran list were used as a Word Association test with the H(11), H(21), and H(31). Because in preliminary testing deaf subjects tended to define the stimulus words and frequently to give multiple word responses, the test was not given to the deaf subjects in the study.

(8) The Equality of Angles of Incidence and Reflection. This task, using a billiard-type apparatus for the discovery and formulation of the principle of the equality of the angles was given to H(11), H(21) and H(31), and to a small number of D(21) and D(31) subjects. The task was extended to include the completion of a set of respresentational drawings. A classification of performance into a Piaget stage and two types of quantitative scores based on the drawings and the manipulation of the appartus were determined. Since the task was given only once it is not included in this report.

IV. RESULTS: NONLANGUAGE MEASURES

Because of the number of analyses included in the investigation results are presented in three sections as follows: IV. Nonlanguage Measures; V. Conservation Tasks; and VI. Vocabulary Measures.

Most of the tabular material is ordered in Appendix A and is referred to frequently in the text. These appendix tables present means, standard deviations, and _t_ values for selected comparisons on quantitative scores, and distributions in number and/or percentage for classification scores. The data are given for hearing and deaf age groups and boys and girls, and for the deaf day and resident school subjects. Tables incorporated in the text present specific additional analyses and some summary data abstracted from the appendix tables. On all tables, levels of confidence are indicated by (*) for the .05 and (**) for the .01 levels. In the discussion, however, only the .01 level is considered significant.

In all tables, an underlined level of confidence or _t_ value indicates that the higher mean score was obtained on the first testing session in longitudinal comparisons; by boys, in sex comparisons; by the younger group in age comparisons; by the deaf in hearing-deaf comparisons; and by resident school deaf subjects in deaf day-resident school comparisons.

Insofar as possible, the results for each test throughout the report are presented under the following headings:

1. <u>First and Second Testing Session Comparisons</u>. Longitudinal data on the same subjects tested twice over a two-year period are separately presented for the deaf and hearing age groups.

2. Sex Comparisons with Age Samples. Comparisons are presented of the performance of boys and girls within the hearing sample and within the deaf sample.

3. Age Comparisons. Comparisons are made of the performance of different age groups within the hearing sample, within the deaf sample and between the hearing and deaf samples. Within the hearing and deaf samples separately, age comparisons were made as follows: (a) Comparisons over a one-year span between different age groups: H/D(12)-H/D(21): CA 8-9 and H/D(22)-H/D(31):CA 11-12. In both comparisons the older age group was being tested a first time, and the younger age group was being tested a second time on a particular measure except in those instances when it had not previously been administered to the H/D(11):CA 6 of H/D(21):CA 9 age groups. (b) Comparisons over a two-year span for the repeated measures on the same groups: H/D(11)-H/D(12):CA 6-8; H/D(21)-H/D(22):CA 9-11; and H/D(31)-H/D(32):CA 12-14. These comparisons are presented under the heading First and Second Testing Session Comparisons. (c) Comparisons over a three-year span between different age groups: H/D(11)-H/D(21):CA 6-9; H/D(21)-H/D(31):CA 9-12; H/D(12)-H/D(22):CA 8-11; and H/D(22)-H/D(32):CA 11-14. The first two comparisons are made between subjects tested for the first time. The last two comparisons are made between subjects tested for the second time on a specific measure except in those instances when it had not been administered to the H/D(11):CA 6 of H/D(21):CA 9 age groups.

Comparisons between the hearing and deaf groups were made between (a) the hearing and deaf groups at the same age, and (b) each deaf group and selected younger and/or older hearing groups.

Progressive Matrices Test (Raven)

Part I (sets A, A_B, B) of the Raven's Progressive Matrices Test was administered to all (H) and (D) groups in the total sample at both

testing sessions. Part II (sets C, D, E) was not administered to the H(11), H(12), D(11) and D(12) groups. Thus, data on the total Raven's test were available for the H(21), H(22), H(31), H(32), and the D(21), D(22), D(31), and D(32) groups. Relevant data for Parts I and II and the Total are presented in Appendix Tables A-IV-1 through A-IV-6.

First and Second Testing Session Comparisons

Hearing. The mean scores for Part I (sets A, A_B, B), Part II (sets C, D, E), and the Total increased for all age groups from the first to the second testing session (see Table A-IV-1). The mean scores on Part I ranged between 16.22 and 32.02; those for Part II between 11.21 and 24.08.

For Part I, the increment in obtained mean scores between H(11) and H(12) was significant (t = 5.78). The increments for the H(2) and H(3) groups between sessions were not significant (t = 0.81 and 1.47, respectively), and the mean scores at the first testing sessions were relatively high.

For Part II, the increases in mean scores between the first and second testing sessions were numerically similar for groups H(2) and H(3), but only the increment for the older group was significant (t = 2.11 and 2.71, respectively).

For the Total mean scores of the H(2) and H(3) groups, the increments between sessions were not significant (t = 1.68 and 2.39, respectively).

Increments in Part and Total scores between sessions were found for all subgroups of boys and girls, except for the H(2) girls who maintained essentially the same score for Part I from Session I to Session II (Table A-IV-2).

On the individual sets of the Progressive Matrices Test, only the

increase in mean scores between H(11) and H(12) on Sets A, A_B, and B reached the .01 level of confidence (Table 4.1). While the scores on

Table 4.1. Raven's Progressive Matrices Test. t Values between Scores for Sets A-E on Session I and Session II by Hearing and Deaf Groups.

Sets	HEARING (1)	HEARING (2)	HEARING (3)	DEAF (1)	DEAF (2)	DEAF (3)
A	3.40**	0.20	0.19	1.25	2.69*	2.11*
A_B	5.38**	1.25	1.19	3.19**	4.96**	3.32**
B	4.73**	0.87	2.19*	4.17**	3.06**	4.33**
C		1.31	2.05*		2.80**	2.34*
D		1.75	1.45		4.22**	1.62
E		2.28*	2.33*		2.39*	0.30

Sets A_B through E increased for groups H(2) and H(3) from Session I to Session II, none of the increments is significant. These groups showed almost identical high scores for the two testing sessions on Set A (Table A-IV-6).

Deaf. The mean scores on Part I, Part II, and Total increased for all age groups from testing Session I to testing Session II (Table A-IV-1). Increments were found for subgroups of boys and girls and for the day and resident school deaf (Tables A-IV-3, A-IV-4). For age groups with sexes combined, the mean scores for Part I ranged between 15.05 and 26.44; those for Part II, between 6.16 and 21.19. For Part I, the numerical increase in scores between the first and second testing sessions was substantial and similar for both the D(1) and D(2) groups. For Part II, the increment for the D(2) group was almost twice that of the D(3) group. All differences in mean scores between sessions were significant at the .01 level of confidence (t = 3.12 and above) for all deaf age groups except for D(3) on Part II (t = 1.59).

On the individual Sets A, A_B, B, the mean scores indicated increas-

ing difficulty for the deaf, greatest for the D(11) group and least for the D(31) group (Table A-IV-6). On Sets C, D, and E, the mean sccres of the D(2) and D(3) groups indicated that these sets also increased in difficulty, with less numerical differences in mean scores between Sets C and D than between Sets D and E (Table A-IV-6). The significances of the differences between the Session I and Session II mean scores of the individual sets, however, varied with the set and the age group (Table 4.1). For no age group was the increase between session scores statistically significant for Set A (the easiest) or Set E (the most difficult).

The significance of the differences between the scores obtained at the first and second testing sessions by the deaf subjects in the day and resident schools are presented in Table 4.2. Although the Ns in the

Table 4.2. Raven's Progressive Matrices Test. t Values between Scores for Part I (A,A_B,B,) Part II (C,D,E), and Total at Session I and Session II for Deaf Subjects Attending Day and Resident Schools.

	DAY SCHOOL DEAF			RESIDENT SCHOOL DEAF		
	(1)	(2)	(3)	(1)	(2)	(3)
Part I (A,A_B,B)	3.09**	5.48**	3.27**	2.63*	3.15**	2.63*
Part II (C,D,E)		1.70	1.02		4.22**	1.31
Total		3.78**	2.51*		4.43**	2.37*

age groups of these subsamples were small, the increment in scores between sessions was significant for Part I (Sets A, A_B, B) for all day school deaf and the D(2) resident school deaf; for Part II (Sets C, D, E), only the increment for the D(2) resident school deaf was significant. (See Table A-IV-4 for the mean scores obtained by the day and resident school deaf subjects on Part I, Part II and Total.)

Sex Comparisons within Age Samples

Hearing. The mean scores for hearing boys and girls by age groups are presented in Table A-IV-2. The performances of boys and girls on

Part I (A, A_B, B), Part II (C, D, E), and the Total were similar. There were no statistically significant differences between hearing boys and girls of the same age at either testing sesion, and each sex obtained half of the higher scores for each Part and the Total.

Deaf. The mean scores for Part I, Part II, and Total are presented in Table A-IV-3 for deaf boys and girls. Although boys scored higher than girls in all except two of the sex comparisons by age and session, the differences were not statistically significant.

Age Comparisons

Table A-IV-5 presents the comparisons for the hearing, deaf, and hearing versus deaf age groups for Part I (A, A_B, B), Part II (C, D, E), and Total. The age groups separated by one year were H/D(12)-(21):CA 8-9 and H/D(22)-(31):CA 11-12. The age groups separated by three years were H/D(11)-(21):CA 6-9, H/D(12-(22):CA 8-11, H/D(21)-(31):CA 9-12, and H/D(22)-(32):CA 11-14. Since the H/D(11) and H/D(12) groups were not administered Part II of the test, comparisons involving them could not be made for other than Part I.

Hearing. On the one-year comparisons, no significant differences were found.

On the three-year comparisons, all differences were significant but that between H(12) and H(22) on Part I.

Deaf. On the one-year comparisons, the differences for Part I were not significant but the younger age groups received higher mean scores than the older. A significant difference was found for the D(22)-D(31) comparison on Part II but not on Total.

On the three-year comparisons, all were significant except one, that between D(12)-D(22) on Part I.

The performances of the day and resident school subjects were compared for the deaf age groups. Of the 14 comparisons, none reached the .01 level of confidence (Table A-IV-4). In all except two instances, however, the day school subgroups received scores higher than their resident school counterparts.

Hearing versus Deaf

The t values for the comparisons between hearing and deaf age groups of the same age are presented in Table 4.3. Substantial similarity was

Table 4.3. Raven's Progressive Matrices Test. t Values between Scores on Part I (A, A_B, B), Part II (C,D,E), and Total between Deaf and Hearing Groups at the Same Ages.

	Part I (A, A_B, B)	Part II (C,D,E)	Total
H(11)-D(11):CA 6-6	0.98	--	--
H(12)-D(12):CA 8-8	1.06	--	--
H(21)-D(21):CA 9-9	2.83**	2.77**	3.40**
H(22)-D(22):CA 11-11	0.07	1.29	0.84
H(31)-D(31):CA 12-12	2.49*	0.85	1.99
H(32)-D(32):CA 14-14	0.17	2.03*	1.76

found in the performances of the hearing and deaf for all three scores, except that the CA 9 age group differences between hearing and deaf were significant at the .01 level of confidence. Consequently, the differences between the scores of the hearing age groups and their day and resident school deaf counterparts were investigated (Table 4.4). The performances of the hearing were not significantly better than that of the day school deaf in any of the 14 comparisons. In five of the comparisons (four on Part I and one in Total), the day school deaf scored higher than the hearing. Except for the CA 6 scores, however, these reversals of expected performances were all in the second session of testing.

Table 4.4. Raven's Progressive Matrices Test. t Values for Part I (A, A_B,B), Part II (C,D,E), and Total between Hearing Subjects and Deaf Subjects of the Same Age Groups Attending Day and Resident Schools.

	DAY SCHOOL DEAF			RESIDENT SCHOOL DEAF		
	Part I (A,A_B,B)	Part II (C,D,E)	Total	Part I (A,A_B,B)	Part II (C,D,E)	Total
H(11)-D(11)	0.09			1.68		
H(12)-D(12)	0.71			2.59*		
H(21)-D(21)	1.75	0.92	1.62	2.53*	3.15*	3.13**
H(22)-D(22)	0.63	0.25	0.18	0.29	1.71	1.17
H(31)-D(31)	2.39*	0.15	1.28	1.82	1.73	1.99
H(32)-D(32)	0.45	1.29	0.73	0.54	1.86	1.36

There was little difference, too, in the hearing and resident age group scores, except for the CA 9 comparisons. The H(21) group scored significantly higher on Part II (C, D, E) and Total. In no instance, however, did the resident deaf score higher than the hearing subjects.

Comparisons of the performance of the deaf and hearing subjects of the same age on Sets A through E are presented in Table A-IV-6. The only difference significant at the .01 level of confidence was found on Set D between the (21):CA 9 groups. Higher, but not significant, mean scores were found for the deaf in four comparisons, two on Set A and two on Set B.

The mean scores for both deaf and hearing at all ages tended to decrease from Set A through E.

In comparisons between each deaf age group with the youngest and oldest hearing age groups (Table A-IV-5), performances on Part I (A, A_B, B) differed from that on Part II (C, I, E) and that on Total. On Part I the deaf subjects in the CA 8 age group and at all older age groups scored significantly higher than the six-year-old hearing (t = 3.40, 2.82, 8.29, 7.00, 16.64 respectively). For Part II (C, D, E) and the

Total, however, only the 14-year-old deaf scored significantly higher than a younger hearing group (Part II (C, D, E) CA 14-9, $\underline{t} = 6.03$; Total, $\underline{t} = 5.89$).

Discussion

A number of studies using Raven's Progressive Matrices Test with the impaired hearing have been carried on since the forties (Costello, 1957; Dunn, 1950; Ewing and Stanton, 1943; Farrant, 1964; Oleron, 1950; Wright, 1955). Except for the one study of college students by Wright and the most recent study by Farrant, the studies are in essential agreement in finding the deaf inferior in performance. They also reported, on the whole, no difference in the performances of boys and girls, and that subjects with the greater hearing losses and the earlier onset of hearing loss are inferior in performance.

In the present study, the age of onset and the degree of hearing loss are not variables since in the sample subjects were deaf and had been so prior to two years of age.

In agreement with the cited earlier studies, this study found no essential differences between the performances of deaf boys and girls or of hearing boys and girls.

However, unlike previous studies with school age children, no general deficit was found in the performances of the deaf in either the cross-sectional or the longitudinal analyses. Except at the one age group, D(21):CA 9, (whose atypical performance can be accounted for by the resident deaf girls in that age group), deaf and hearing children of the same age performed similarly. Furthermore, except at this same age level, the performances of the hearing did not differ from that of the residential or day school deaf; and the residential and day school deaf did not differ from each other. In addition, for Part I (A, A_B, B),

deaf children at CA 8 scored significantly higher than the hearing children at CA 6.

Previous studies have found that with increasing age the differences in performances of deaf and hearing become greater (Templin 1950, 1954a, Oleron 1950). This result was not found in the present study since the deaf were not inferior to the hearing of the same ages through the range tested.

Previously, Templin (1950, 1954a) reported increased inferiority of the deaf as the material considered was more difficult or abstract. On the Raven's Progressive Matrices results reported here, comparison of the performances of the deaf and the hearing of the same age on Part I (A, A_B, B) and Part II (C, D, E) did not show any increase in the significance of differences with the increasing difficulty of the set. Similar comparisons on Sets A through E showed no differences between deaf and hearing.

The longitudinal data, however, suggest a somewhat different growth pattern for the deaf than for the hearing. Examination of the t values on test-retest performance of the hearing suggest that the youngest subjects show the greatest improvement in the easier materials and that the oldest show substantial increments on harder material. For the deaf, however, the data suggest a longer period of improvement on easier material and a slower rate of improvement on more difficult material over the age range studied, since the increments on the easiest material continue to be significant through the oldest age group while those on the harder material are not significant at the oldest age.

Examination of the increments on the separate sets lends some support for different growth patterns of hearing and deaf. For the hearing, significant increments on the separate sets occur only for the

youngest group on the three easiest parts. For the deaf, however, significant increments occur at all ages, and for all parts except the easiest and the hardest. While the youngest and the middle-aged deaf show a substantial number of significant increments, the oldest deaf show significant differences only for the easier sets (except the easiest on which the initial score is about three-fourths of the maximum). As the sets become more difficult the increments continue significant for the middle-aged deaf, but not for the oldest deaf. On the most difficult set, however, the increment is significant for neither the middle nor the oldest deaf. It should also be noted that the deaf are less consistent in their performances from test session to test session.

Thus there is a somewhat tenuous indication that while simple age comparisons do not indicate a significant deficit in the performance of the deaf, the longitudinal comparisons suggest variations in the rate of improvement in the same children over time related to both the age of the subjects and to the difficulty of the materials.

The question of the essential differences in the results of this study from those of other studies on the Raven's Progressive Matrices must be faced. As Myklebust (1964, p. 87) has pointed out, the explanation that the deaf will be inferior on tasks requiring the deduction of a principle that can be applied to a number of items, whether or not the task involves verbalization, cannot be arbitrarily applied.

The reason for the different results cannot be found in the particular sample. Recognizing the difficulty in assessing the intelligence of the deaf, it can, nevertheless, be assumed that the deaf sample is similar to the hearing sample in having essentially average intelligence. While there were probably no mentally retarded children in the sample, neither was the sample one of accelerated children.

The administration by pantomime cannot be expected to have given the deaf sample any special advantage since once a subject started he continued through the matrices according to the manual. Other studies also used pantomimed instructions with the deaf.

It seems that the likely explanation is in the environment -- particularly school -- of the children. At the time that the testing was carried on, the subjects were not attending schools that were unusually advanced in the use of oral methods. However, most of the other studies reporting in detail the use of the Raven's Progressive Matrices Test were carried on between one and two decades earlier than the present one. It is reasonable to conjecture that since the end of World War II the out-of-school environment of the subjects has become more stimulating and that a growing emphasis on the increasing variety and quality of the environment of children should have permeated all schools. Templin[1], in a replication of Lehman and Witty's (1928) study of play activity, for example, found children in the 1950's engaging in many more activities than children in the 1920's. This may well be an example of the diffusion of these increasingly accepted attitudes and practices into the specific testing environment. This emphasis may account for a measured decrease (which may logically well be a real decrease) in the differences in the performances of children on a test that through a nonlanguage measure assesses the child's ability to deduce a principle and apply it.

In fact, Oleron, in 1950, discussed the possibility of the findings of this study when, in considering the inferiority of the 9-to-21-year-old-deaf on the 1938 Progressive Matrices, he suggested that "The sphere of abstract thought is by no means closed to the deaf. If the access to it is more difficult for him than for the hearing it is no less true

1 Unpublished study.

that progress in and choice of the methods of education permit to reduce the difficulty" (p. 192). Oleron was, of course, concerned primarily with the relation between language and thought. Nevertheless, for problems in which the solution to a number of items is dependent upon the application of a principle, a more generally stimulating educational environment, although not necessarily a more verbal one, may well improve performance.

Weigl-Goldstein-Scheerer Color Form Sorting Test

Performance on the Color Form Sorting Test was classified into Concrete and Abstract categories. The number of performances in each category is presented in Table A-IV-7 for the hearing and deaf age groups and for subgroups. Because of the small number of cases in many cells, comparisons on this measure are largely descriptive. However, McNemar's Test for Significance of Changes and Fisher's Exact Probability Test were used to determine whether their proportions of classification differed. As older subjects are considered, the distribution of performance is expected to include more Abstract and fewer Concrete responses.

First and Second Testing Session Comparisons

Hearing. Between the first and second testing sessions, shifts in the proportion of classifications of the performance of H(1), H(2), and H(3) groups occurred as expected; that is, the number of performances that could be classified Abstract increased and the number that could be classified Concrete became correspondingly smaller. None of the distributions, however, differed significantly, although for the H(2) group the .05 level of confidence is reached. For the H(1) at both testing sessions about 2/5 of the performances could be classified as Abstract and 3/5, as Concrete. At the second testing session, except for two performances by subjects in the H(2) group and one in the H(3) group, all performances were Abstract. For the H(22) group, 8 of the Abstract

performances represented induced shifts. For the H(32) group, however, all except one Abstract performance represented a spontaneous shift. Performance at the first testing session was about 1/3 Concrete for the H(2) group; at both testing sessions performance was about 1/6 Concrete for the H(3) group.

Deaf. For the deaf, the expected change in the distribution of Abstract and Concrete performances did not occur consistently at the second testing session, and in no instance did the distributions differ significantly at the .01 level nor reach the .05 level of confidence. Probably the small number of Abstract performances that did occur for the D(1) and D(2) groups is of more interest than the slightly smaller number of Abstract performances for the D(1) group and the slightly higher number for the D(2) group at the second testing session. Concrete performance predominated in both testing sessions for these groups. The D(1) group scored only two Abstract performances at the first testing session and none at the second; the D(2) group scored one Abstract performance at the first and four at the second testing session. While the distributions of Abstract and Concrete performances of the D(3) groups were similar for the two testing sessions, the level of performance was also high: about 5/6 of the performances at both sessions were Abstract.[2] There was, however, a tendency for more spontaneous shifts to occur at the second testing. At the D(31) testing, about 1/2 of the Abstract responses represented induced shifts. At the D(32) testing, however, only one performance classified Abstract was not spontaneous.

Sex Comparisons within Age Groups

Hearing. The distribution of Abstract and Concrete performances of

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[2] The percentage distribution of Abstract and Concrete performances remains about the same from D(31) to D(32) testing despite the fact that data were not available on 7 subjects in the former age group.

hearing boys and girls is similar for all age groups (Table A-IV-7). Although the performances of more girls are classified Abstract at five of the six age comparisons, the distributions for the two sexes were not significantly different.

Deaf. The distribution of Abstract and Concrete performances for deaf boys and girls were similar at all age levels. The distribution of performances included more Abstract performances by girls in four of the six comparisons. However, the distributions did not differ significantly.

Age Comparisons

Hearing. The comparison of distributions of the Abstract and Concrete performance for hearing age groups separated by one year varied in the expected directions. While the comparison of distributions between H(12):CA 8 and H(21):CA 9 did not differ significantly, the number of Concrete performances were 14 at CA 8 and 9 at CA 9, and the number of Abstract performances were 10 at CA 8 and 15 at CA 9. However, spontaneous shifts made up about 4/5 of the Abstract performances at both ages. Comparison of the distributions at H(22):CA 11 and H(32):CA 12 did not differ significantly, nor did they reflect the expected changes at the older age. The number of Concrete responses was 2 at the younger and 5 at the older age group; the number of Abstract performances was 22 and 19 respectively. However, about 4/5 of the Abstract performances represented spontaneous shifts at the older age, and about 2/3 represented such shifts at the younger age group.

In all comparisons between age groups separated by three years, the distributions of Abstract and Concrete performances occurred as expected. However, it was only between H(12):CA 8 and H(22):CA 11 that the distributions differed significantly. In all comparisons the proportion of spontaneous shifts represented in Abstract performances was greater at

the older age. At age level CA 11 and above, the performance of the subjects was characteristically Abstract. The percentage of spontaneous shifts in the Abstract performance was high at all ages, varying from about 64 to 93 per cent. At H(32):CA 14, practically all performances were Abstract and nearly all Abstract performances represented spontaneous shifts.

Deaf. The distribution of Concrete and Abstract performance of the deaf age groups separated by one year were practically identical at D(12):CA 8 and D(21):CA 9. However, for the D(22):CA 11 and the D(31): CA 12 groups, the distribution differed significantly and in the expected directions. At CA 11, about 4/5 of the performances were Concrete and about 1/2 Abstract. At CA 12, however, the reverse proportion was found with about 1/6 of the performances, Concrete and about 5/6, Abstract.

Comparisons of the distributions for age groups separated by three years indicated that the performances remained essentially Concrete and did not differ significantly for D(11):CA 6 and D(21):CA 9, nor for D(12): CA 8 and D(22):CA 11. However, the performances of the subjects at D(31): CA 12 and at D(32):CA 14 was essentially Abstract. Comparisons across three years that include these older age groups i.e., D(21):CA 9 with D(31):CA 11, and D(22):CA 11 with D(32):CA 14, showed significant differences and, of course, in the direction of higher level performance at the older ages.

On the whole the distributions of the day and the resident school deaf at the same age levels did not differ. In only one instance, D(31):CA 12 was a statistically significant difference possible; the day school group performed at a considerably higher level than the resident school group. No statistical test was made, however, since a number of the test results of the resident students at CA 12 were not available,

and the distributions of Concrete and Abstract performances of all day and resident school subjects did not differ at CA 14.

Hearing and Deaf. Age for age, the deaf showed a higher percentage of Concrete performance and a lower percentage of Abstract performance than hearing subjects. However, only at CA 11 did the distributions of performance differ significantly. This finding reflects the differences in the ages at which the performance of the deaf and the hearing become essentially Abstract. After CA 11 for the hearing, and after CA 12 for the deaf, Abstract performance became most characteristic. At CA 14, the oldest age tested, performances of the hearing were about 95 per cent, and of the deaf about 80 per cent, Abstract.

Comparisons of the deaf and hearing at various ages included in the study indicated that in the distribution of the classification of performance, the deaf after CA 12 were similar to the hearing at CA 11, 12, and 14. This means that the 12 and 14 year old deaf are essentially Abstract in their performance. The distributions of performances of the deaf at CA 12 and 14 were both significantly different (and more mature) from that of the hearing at CA 6. However, the distributions of Concrete and Abstract performances of the deaf at CA 11, 9, and 8 did not differ from that of the CA 6 hearing.

Between 11 and 12 years of age, the performance of the deaf changed quite radically from essentially Concrete to essentially Abstract. Characteristic Abstract performance occurred more gradually from age to age for the hearing. It is not possible from the present data to know whether this sudden change is characteristic of the deaf or whether it is related to the particular deaf sample tested. At no point were the hearing as definitely Concrete in their performance as the deaf. The sudden increase in Abstract performance for the deaf differed from the

less dramatic change for the hearing, although the latter also, presented substantially more Abstract performances between CA 9 and 11.

Category of Initial Sorting. Initial sorting of the blocks was done according to color, form, or a mixed category, i.e., some combination of color and form. When all performances of the subjects in age groups CA 6, 8, 9, 11, 12, and 14 were considered, the hearing subjects initially sorted about equally on the bases of color (50.7%) and form (48.6%), and practically never sorted on a mixed category (0.7%). The deaf, on the other hand, initially sorted on the basis of color (59.1%) more frequently than on the basis of form (28.3%); mixed sorting accounted for 12.6 per cent of their initial sorting.

In Table 4.5, the percentage of Concrete and Abstract performances

Table 4.5. Percentage of Concrete and Abstract Performances According to Category of Initial Sorting by Hearing and Deaf Samples.

	Hearing				Deaf			
		Abstract				Abstract		
Initial Sorting	Concrete	Total	Spontaneous	Induced	Concrete	Total	Spontaneous	Induced
Color	63.0	44.9	49.4	26.3	68.7	41.5	43.8	33.3
Form	37.0	55.1	50.6	68.4	11.8	58.5	56.3	66.7
Mixed	0.0	0.0	0.0	3.5	19.7	0.0	0.0	0.0

are presented according to the category of initial sorting. About 2/3 of the performances classified as Concrete were initially sorted on the basis of color by both hearing and deaf. For the hearing, the remaining 1/3 were initially sorted on form. For the deaf however, the remaining 1/3 were initially sorted according to the mixed category about twice as frequently as according to form.

When performance classified as Abstract is considered, however, the patterns for the hearing and deaf are very similar: Somewhat more

than one-half of the Abstract performances in a spontaneous shift were initially sorted on the basis of form. Approximately 2/3 of the induced shifts, however, were initially sorted on the basis of form. No initially mixed sorting by the deaf, and only one by a hearing subject, were classified Abstract.

In Table 4.6, the percentage of initial color, form, and mixed sortings is presented according to the Abstract or Concrete performances.

Table 4.6. Percentage of Initial Color, Form, and Mixed Sorting According to Later Classification of Performance as Abstract or Concrete by Hearing and Deaf Samples.

Classification of Performance	Hearing			Deaf		
	Color	Form	Mixed	Color	Form	Mixed
Concrete	39.7	24.3	0.0	75.4	27.3	100.0
Abstract	60.3	75.7	-[1]	24.6	72.7	0.0
Spontaneous	88.6	75.5	0.0	82.4	75.0	-
Induced	11.4	24.5	-[1]	17.6	25.0	-

[1] Not calculated. Only one initial sorting by Mixed categories occurred.

Performance of the hearing and the deaf was similar if the initial sorting is on the basis of form. About one-quarter of the performances in which the initial sorting was on the basis of form were classified as Concrete, and about 3/4, as Abstract. Furthermore, for both hearing and deaf, the same percentages of spontaneous and induced shifts occurred when the initial sorting is according to form.

If the initial sorting is on the basis of color or a mixed category, however, the performance of hearing and deaf vary. When initial sorting was by color, about 40 per cent of the performances of the hearing and about 75 per cent of those of the deaf did not shift and were classified Concrete. For the entire deaf sample, proportionately more

Concrete performances occurred at the younger ages. It is interesting however, that they were not evenly distributed, but were associated with initial sorting by color. When deaf children initially sorted on the basis of form, the classifications of their performances were almost identical with those of the hearing. Initial mixed sortings by the deaf were all classified as Concrete. The one hearing subject who initially sorted on a Mixed category later shifted and his performance was classified as Abstract.

Gelb-Goldstein Color Sorting Test

Although both classification and quantitative scores were obtained in the Color Sorting Test, the classification of performance into Abstract and Concrete is basic in the presentation of the results. The number of Abstract and Concrete performances for the test as a whole is presented in Table A-IV-8, and for the separate experiments in Table A-IV-9.

First and Second Testing Session Comparisons

Hearing. The hearing at H(1), H(2), and H(3) showed substantial shifts in the expected directions from the first to second testing sessions in the proportions of Abstract and Concrete performances. In Table 4.7, it is seen that the distributions differed significantly for

Table 4.7. Levels of Significance of Differences in Proportions of Abstract and Concrete Classifications on Color Sorting Test by Hearing Age groups at First and Second Testing Sessions.

			Experiment				
	CA	Total Test	I	IIa	IIb	III	IV
H(11)-H(12)	6-8	.05	NS	NS	.05	NS	.01
H(21)-H(22)	9-11	.01	.01	NS	NS	NS	NS
H(31)-H(32)	12-14	.01	.01	.05	NS	NS	.01

NS = not significant

the middle and oldest age groups and reached the .05 level for the youngest age group. The proportion of Abstract performances at the second testing session was substantial for all three groups: 3/8 for H(1), 3/4 for H(2), and all performances for H(3).

All shifts in the proportions of Abstract and Concrete performances between testing sessions for the separate experiments were as expected with one exception (Experiment IIa, H(11)-H(12):CA 6-8). However, the patterns of magnitude and the levels of significance of shifts varied with the several experiments. In Experiments I and III, the subjects sorted to a given color. When the color was indicated by name (Experiment III), by far the highest number of Abstract performances occurred. Because of this high percentage of Abstract performances at the initial testing, the shifts in the proportion of Abstract and Concrete performances were not significant. At the initial testing, for instance, 7/8 of the performances of the youngest age group were Abstract.

In Experiment I, when sorting was done to a sample skein of yarn without verbalization of the color name, the proportion of Abstract performances at the first testing session was considerably lower, and the changes in distribution of Abstract and Concrete performances were significant for the middle and oldest ages. At the second testing session, nearly 3/4 of the performances of the H(1) group were Abstract, 11/12 of the H(2) group, and all performances of the H(3) group.

Subjects' ability to match yarns on hue or brightness and then to shift the dimension of matching was considered in Experiments IIa, IIb, and IV. Performances on IIb, except for the H(1) at the first testing, were essentially Abstract. Performance on Experiments IIa and IV were somewhat more Concrete, with the exception of the second testing of the H(3) group. When the subject was confronted with substantially more

skeins of yarn in Experiment IV, the shifts in the proportion of Abstract and Concrete performances were significant, however.

Deaf. On the Color Sorting Test as a whole, the performance of the D(1), D(2), and D(3) age groups was predominately Concrete at both the first and second testing sessions. While the proportions of Abstract and Concrete performances shifted slightly as expected from the first to the second testing session, the distributions did not differ significantly (Table 4.8). Abstract performances occurred for fewer than one-fourth of the performances of H(32).

Table 4.8. Levels of Significance of Differences in Proportion of Abstract and Concrete Performances on Color Sorting Test by Deaf Age Groups at First and Second Testing Sessions.

			Experiment				
	CA	Total Test	I	IIa	IIb	III	IV
D(11)-D(12)	6-8	NS	.01	NS	NS	.05	NS
D(21)-D(22)	9-11	NS	NS	NS	NS	NS	NS
D(31)-D(32)	12-14	NS	NS	NS	NS	.05	NS

NS = not significant

The performance of the deaf varied among the separate experiments. On the three experiments testing the ability to shift matching on hue or brightness (IIa, IIb, IV), the performances of the deaf were Concrete, at only one age were as many as 1/3 of the performances classifiable as Abstract. Furthermore in five of the nine comparisons between first and second testing sessions, the shift in the proportions of Abstract and Concrete performances were not in the expected direction; the same subjects exhibited a slightly higher proportion of Concrete and a lower proportion of Abstract performances at the second testing.

The Abstract performances of the deaf occurred for the most part

on Experiments I and III. The highest number of Abstract performances were found on Experiment III in which sorting was done to a named color. The shifts in proportions between testings were significant for the D(1) and the D(3) groups. For the younger age group, Abstract performances shifted from about 1/4 of the subjects D(11) to about 3/5 for D(12); from about 2/3 for D(21) to about 9/10 for D(22); and from over 2/3 for D(31) to all except one for D(32). The proportion of Abstract performances on Experiment I (sorting to a selected skein) was lower, but about 2/3 of the performances of the D(31) and D(32) groups were Abstract; 1/3 for D(21) and 2/3 for D(22); and about 1/8 for D(11) and 2/5 for D(12).

Sex Comparisons with Age Groups

Hearing. For all six age groups the distributions of Abstract and Concrete performances for hearing boys and girls on the test as a whole were similar. For four age levels a higher proportion of Abstract and a lower proportion of Concrete performances occurred at a nonsignificant level for girls; for two levels the proportions for boys and girls were the same.

Deaf. Considering the Color Sorting Test as a whole, deaf boys and girls did not differ in the proportion of Abstract and Concrete performances at any of the age levels tested.

Age Comparisons

Hearing. Hearing age groups did not steadily show more mature distributions of Abstract and Concrete performances from age level to age level on the test as a whole, although over the entire age range tested the trend was toward a higher proportion of Abstract performances. The proportion of Abstract performances of age groups at the second testing was consistently higher, although not at a significant level, than that of one year older subjects at the initial testing. Thus, the distri-

bution of Abstract and Concrete performances of hearing subjects between H(21):CA 8 and H(21):CA 9 did not differ significantly, and the CA 8 age group had a higher proportion of Abstract performance. Similarly, the distributions for the H(22):CA 11 and H(31):CA 12 did not differ significantly and the CA 11 group had the higher proportion of Abstract performance.

Considering the separate experiments, a higher proportion of Abstract performance was scored by H(12):CA 8 than by H(21):CA 9 on each of the experiments except Experiment III (sorting to a named color) on which 22 Abstract performances occurred at both ages. Between H(22):CA 11 and H(31):CA 12 the proportion of Abstract performances did not increase at the older age level for any of the experiments.

In comparisons over a three-year span, the distributions of Abstract and Concrete performances shifted toward a greater proportion of Abstract and a correspondingly lower proportion of Concrete performances at all older ages on the test as a whole and on the separate experiments. The changes in the distributions for the test as a whole were quite substantial, but only the distributions between H(22):CA 11 and H(32):CA 14 of all three-year comparisons differed significantly. The proportion of Abstract performances was higher for the separate experiments in all comparisons over the span of three years.

Deaf. Low level of performance and relatively little variation with age were most characteristic of the performances of deaf subjects throughout the six age levels tested. On the test as a whole, there was no trend toward a higher proportion of Abstract performance with age in the distributions separated by one year (D(12):CA 8 and D(21): CA 9 or between D(22):CA 11 and D(31):CA 12), or those separated by three years (D(11)-D(21):CA 6-9; D(12)-(22):CA 8-11, D(21)-(31):CA 9-12,

and D(22)-(32):CA 11-14). None of the distributions are significantly different.

Only on those separate experiments in which sorting was done to a color (Experiments I and III) did the deaf have any substantial number of Abstract performances. In Experiment III (sorting to a color name) the percentage of Abstract performances at D(11):CA 6 was less than 25 per cent, but at all other age levels, the proportion of Abstract performances ranged from about 60 to 95 per cent. In Experiment I (sorting to a colored skein) about 1/9 of the performances at D(11):CA 6 and 1/3 at D(21):CA 9 were Abstract. However, the performance was about 2/3 Abstract at the other ages: D(12):CA 8, D(22):CA 11, D(31):CA 12, and D(32):CA 14.

For Experiments IIa, IIb, and IV in which matching was to hue or color, performance was classified Abstract if the subject shifted the dimension of matching. On only one of the 18 instances did the percentage of Abstract performance approach 50 per cent. In 15 instances less than 1/4 of the performances were Abstract.

Neither the day nor resident school deaf accounted for the substantially fewer Abstract performances of the sample. On the test as a whole, performances of only 8.5 per cent of the day school deaf were classified Abstract, and only 10.3 of the resident deaf.

Hearing and Deaf. At the same ages as the deaf, hearing groups consistently had a higher proportion of Abstract performances (Tables A-IV-8, A-IV-9). Comparisons of the distributions of Abstract and Concrete performances for the total test and for the separate experiments are presented in Table 4.9. For the total test, differences in the proportions of Abstract and Concrete performances were statistically significant for the H(22)-D(22), H(31)-D(31), and H(32)-D(32) groups.

Table 4.9. Levels of Significance of Differences in Proportion of Abstract and Concrete Performances on Color Sorting Test by Hearing and Deaf at the Same Age Levels.

	CA	Total Test	Experiment I	IIa	IIb	III	IV
H(11)-D(11)	6-6	NS	.01	NS	.05	.01	NS
H(12)-D(12)	8-8	NS	NS	NS	.01	.05	.01
H(21)-D(21)	9-9	NS	NS	NS	.01	NS	.05
H(22)-D(22)	11-11	.01	.05	NS	.01	NS	.01
H(31)-D(31)	12-12	.01	NS	NS	.01	NS	.01
H(32)-D(32)	14-14	.01	.01	.01	.01	NS	.01

At CA 14, the oldest age tested, with the single exception of sorting to a color name (Experiment III), the hearing group had proportionately more Abstract performances at a significant level in the separate experiments.

On the total task, the distributions of Abstract and Concrete performances of the H(11):CA 6 and the D(32):CA 14 age groups were identical (Table A-IV-8). The six-year-old hearing did not differ significantly in the distribution of Abstract and Concrete performances from that of any of the deaf age groups. The deaf, then, most resemble the six-year-old hearing on the total task. However, in Experiment III, sorting to a color name, the deaf and hearing at CA 14 were similar in their performance.

Characteristics of Sorting in Experiments IIa, IIb, and IV

Performance of the deaf on Experiments IIa, IIb, and IV was mostly Concrete. The initial response of the hearing subjects on Experiments IIa and IIb was most frequently on the basis of hue, and an irregular increase occurred between CA 6 and CA 13 in this choice (65 to 95 per cent). An irregular decrease in initial brightness responses from 0 to 4 per cent also occurred. In only a few instances (1 to 8 per cent of

the opportunities) did the hearing reject a shift from hue to brightness or vice versa.

The pattern of responses of the deaf differed considerably. Although hue was the most frequent initial response, this choice was less predominant (37 to 65 per cent). Initial brightness responses were very few (0 to 6 per cent) and rejection of shift was high (34 to 62 per cent). No age trends were apparent.

In Experiment IV there were no age trends for the hearing or the deaf. The initial response to brightness was most frequent for both hearing and deaf, although more frequent for the hearing. Here too, the deaf rejected shift more frequently than the hearing.

<u>Quantitative scores</u>. Concrete and Abstract quantitative scores were obtained by summing the performances on the items so classified for the separate experiments and the test as a whole. Means and standard deviations for the quantitative Abstract scores and $\underline{t}$ values for selected comparisons are presented in appendix tables A-IV-10 to A-IV-15. With the very few exceptions when no response was given to a particular item, the Concrete score is the obverse of the Abstract score. Therefore, only data on the quantitative Abstract score are presented in the appendix. Since these quantitative scores are not wholly independent of the classification score, the results are not systematically reviewed in detail. Classification scores were assigned each Experiment. Quantitative scores grouped Experiments I and III (sorting to a color) and Experiments IIa, IIb, and IV (matching to hue or brightness and subsequent shifting). Thus, results on separate experiments are not directly comparable.

Analysis of the quantitative scores substantiate the findings based on the classification scores. Longitudinal comparisons for the hearing indicated an increase in mean Abstract and decrease in mean Concrete

scores between sessions at a significant level for H(2) and H(3). For the deaf longitudinal, shifts were neither consistent nor significant (see Tables A-IV-10, A-IV-12).

On combined Experiments I and III (sorting to a color), the increases in mean Abstract and the decreases in mean Concrete scores were significant between the first and second testing for H(2) and H(3). For the deaf the shifts between sessions were in the expected directions, and were significant for the D(1) group. On combined Experiments IIa, IIb, and IV, the hearing shift was expected, but only the shift for H(3) was significant. For the deaf, however, the expected shifts did not occur and no significant changes between the first and second testing sessions were found.

No significant differences in the mean number of Abstract or Concrete responses were found for the hearing or deaf between boys and girls at any age level on the test as a whole, or for combined Experiments I and III, or combined Experiments IIa, IIb, and IV (see Table A-IV-11, A-IV-13).

In cross sectional comparisons among the hearing, higher Abstract mean scores and lower Concrete mean scores were made by 8-year-olds as compared to 9-year-olds, and 11-year-olds as compared to 12-year-olds, although not at a significant level. The same was true for the CA 8 and CA 9 year old deaf but not for the 11 and 12 year olds (see Tables A-IV-15).

In comparisons over a three-year period for the hearing, the older age group received the higher mean Abstract and the lower mean Concrete scores, and the differences between 11 and 14 years were significant. In similar comparisons, the direction of higher mean scores was inconsistent for the deaf, and only the comparisons between CA 6 and 9 on

Experiments I and III were statistically significant and in the expected directions (see Tables A-IV-15).

Resident and day school deaf at the same ages did not differ in performance (see Tables A-IV-14).

The deaf received lower Abstract and higher Concrete mean scores than the hearing at all six age levels tested. The differences reached a significant level at ages 11, 12, and 14. The deaf groups at all ages tested did not differ significantly from the H(11):CA 6 group in mean Abstract or Concrete scores on the Total test (see Tables A-IV-15, A-IV-21). The H(11):CA 6 group had a higher mean Abstract score than any deaf age group.

Discussion of Sorting Tests

Although the deaf were inferior to the hearing on the sorting tests, the amount and pattern of inferiority varied with the particular task.

On Color Form, sorting inferiority was most apparent at the younger ages and was characterized by a rather sudden shift toward Abstract performance of the deaf at age 12. The performance of the deaf at the two oldest ages tested, were similar to that of the same aged hearing in that they were essentially Abstract. Although Abstract performance was more frequent for both hearing and deaf subjects at the older ages, the hearing achieved essentially Abstract performance at a younger age. This is reflected in the similarity of performance of the hearing and the deaf at the younger and older ages and in the significant difference in their performances at CA 11. The groups of the same hearing and deaf subjects tested after a period of two years did not significantly change in performance level. The deaf subjects initially tested at 12 years, however, performed at a significantly higher level than those deaf subjects whose second testing occurred at age 11. Another indication of

the sudden shift in Abstract performance of the deaf is seen in the 12-year-old deaf's performances at a level significantly above that of the 6-year-old hearing, while the 11-year-old deaf actually had a higher proportion of Concrete performances.

On the other hand, the inferiority of the deaf is more apparent at the older ages on the Color Sorting Test as a whole. Comparisons between deaf and hearing at 6, 8, and 9 years did not indicate significant differences in proportions of Abstract and Concrete performance, but at 11, 12, and 14, the deaf were significantly inferior. Whether classification or quantitative scores are considered, the hearing tend to show more significant increments between testings than the deaf. Furthermore, both on the total test and for the separate experiments, for the deaf a higher proportion of Concrete performance at the second testing is not unusual.

The separate experiments on the Color Sorting Test emphasize the specific nature of the Abstract performance of the deaf subjects. The greater frequency of initial sorting on color by the deaf agrees with the finding of Doehring (1960). Nevertheless, the tasks demanding sorting to a color are, for the most part, performed by the deaf at a level more comparable to that of the hearing than are those demanding choice of hue or brightness for matching and then a shift of dimension. Only on sorting to a named color is the performance of the deaf essentially Abstract and not different from that of the hearing, however.

On tasks demanding sorting behavior, the deaf functioned reasonably well. On tasks demanding shift they varied. The shifts of the older aged deaf were equal to the hearing when basic sorting categories were form or color. However, these same children tend, for the most part, to be very inferior to the hearing when shift is expected to be carried on in a less structured situation and when more subtle differences (hue

or brightness of skeins of yarn) form the basis for shift. Thus, it is not a simple question of rigidity or inability to shift that is raised.

In the published literature, reports on shifting ability of the deaf varied, and, unfortunately, the tasks used also differed. McAndrew (1948) found that subjects approximately 12 years old had substantial difficulty in restructuring or shifting the field or classification of 25 objects in 5 categories. Only 4 of 25 deaf children studied succeeded in shifting the classification while all the blind and normal subjects were able to shift or reclassify, although the blind required more trials than the normal children.

When the first testing on the present study was under way or completed, a series of studies was published that have attempted to separate the classificatory from the verbal aspects of performance (Kates, Kates, Michael, and Walsh, 1961; Kates, Yudin, and Tiffany, 1962; Kates, Kates, and Michael, 1962). Using the Object Sorting test from the Goldstein-Scheerer battery as well as other tasks, they reported that the deaf, for the most part, were similar to the hearing on categorization that was judged independently on verbalization, and they suggested that the deaf resemble younger hearing children.

The fact that in the present study the same deaf subjects differed substantially in performances on the several classification tasks, suggests that at this point no attempt should be made to generalize on the shifting behavior of the deaf, but that further study on the specific factors involved in shifting behavior on a number of tasks should be studied systematically. The work of Kates _et al_. provides a framework under which some further study could be carried on.

V. RESULTS: CONSERVATION TASKS

Classification of a subject's performance into Stage III represents the attainment of a concept and is referred to as a conservation response. On the basis of the distribution of performance into Stages I, II, and III (or below Stage I), the level of understanding of conservation attained by groups or subgroups can be evaluated. Thus, if more performances are classified at the upper stages, the group's understanding of conservation is better, and if more are classified at the lower stages it is poorer.

Classification of performance into stages was reliable. For the conservation of substance, weight and volume, 14 or 15 protocols were randomly selected and independently classified by a second scorer. Only 7 discrepancies occurred, and all except one on the Conservation of Substance Task were between Stages I and II. After discussion complete agreement was reached by the scorers.

Because of the small number of performances at some of the stages, much of the classification data presented is essentially descriptive. When comparisons were made between performances of specific groups or subgroups, the distributions on the Piaget stages were first inspected, and if it was apparent that the distributions were similar, no statistical technique was applied. However, if inspection suggested that the two distributions might diverge from one another, the chi square technique, using the formula for small <u>N's</u>, was applied (Hays, 1963). Only for those comparisons in which the probability level reached .01 was the null hypothesis of no differences in the distributions rejected, and the divergence referred to in the discussion as significant.

Distributions of the classification of the performances of the deaf and hearing according to Piaget stages are presented in Appendix A by number and per cent.

Quantitative scores for the Conservation of Number, Substance and Weight Tasks are presented in Appendix A. Significance of differences were, for the most part, determined for the same array of comparisons as on other measures.

Conservation of Number

Distributions of performances classified below Stage I and at Stages I, II, and III are presented in Tables A-V-4, and A-V-5. Relevant data on the quantitative conservation of number scores are presented in Table A-V-6.

First and Second Testing Session Comparisons: Piaget Stages

Hearing. Since the Conservation of Number Task was not given to the H(3) group, longitudinal comparisons were possible only for the H(1) and H(2) groups. Both showed substantial increases over the two-year period in conservation responses: Stage III responses increased from the first to the second testing for the H(1) group from 8.3% to 33.3% and for H(2), from 58.3% to 83.3%. Examination of the distributions into Piaget stages indicated a generally higher level of understanding of conservation at the second testing session. Thus, the H(1) group showed an increase in Stages II and III performances and a decrease in Stage I; the H(2) group showed a decrease in Stage II and an increase in Stage III. No H(2) performance at either session was in Stage I. The distributions into Piaget stages at the two testings diverged significantly for the H(1) group (chi square = 10.14, 2 df) but not for the H(2) group.

Deaf. No longitudinal comparisons were possible for the D(1) group since it was not tested on the Conservation of Number Task at the first session. Conservation responses increased substantially for both the D(2) and the D(3) groups. Stage III performances increased between testing sessions from 26.3% to 57.9% for the D(2) group, and from 54.2%

to 100% for the D(3) group.

Inspection of the distributions into all Piaget stages showed that both deaf groups had shifted toward a higher level of understanding of conservation at the second testing session. For the D(2) group the percentage of performances at Stage I decreased and at Stages II and III increased. For the D(3) group the number of performances at Stages I and II decreased and increased at Stage III. The latter increase was the most substantial shift noted for the deaf. The distributions at the two sessions diverged significantly for the D(3) group (chi square = 14.20, 2 df).

Sex Comparisons within Age Groups: Piaget Stages

Hearing. Boys and girls at the four age levels tested did not diverge in the general level of understanding of conservation attained. The number of conservation responses given was similar at the younger ages, but at CA 9 and CA 11 boys gave conservation responses slightly more frequently.

Deaf. At the five ages tested, the level of understanding of conservation by boys and girls was similar. On the whole, the number of conservation responses given was also similar. The one possible exception was CA 12 boys, who gave about one-sixth more conservation responses than CA 12 girls.

Age Comparisons: Piaget Stages

Hearing. From age level to age level, the four hearing groups showed steady increases in the number of conservation responses: performances at Stage III increased from 8.3% for the H(11):CA 6 to 83.3% for the H(22):CA 11 group.

Over the age range, consistent progress toward better understanding of conservation occurred. Stage I performances declined from 37.5% at

H(11):CA 6 to 4.2% at H(12):CA 8, and no Stage I performance occurred at H(21):CA 9 or H(22):CA 11. The distributions of Piaget stages for age groups separated by one year -- H(12)-H(21):CA 8-9 -- did not diverge significantly. For age groups separated by three years only the distributions of the H(11)-H(21):CA 6-9 groups diverged significantly (chi square = 18.38, 2 df).

Deaf. The increase in percentage of conservation responses of deaf subjects was irregular from age level to age level, but was apparent over the age range covered: Stage III accounted for 35.3% of performances at D(12):CA 8 and for 100% of performances at D(32):CA 14.

The progress of the deaf toward a higher level of understanding of conservation was also irregular from age level to age level. Although 29.4% of the performances of the D(12):CA 8 group were classified below Stage I, no performances were so classified at D(21):CA 9 or older. From the D(12):CA 8 to the D(32):CA 14 groups, Stage I performances decreased from 5.9% to none; Stage II performances decreased from 29.4% to none; and Stage III performances increased from 35.3% to 100%.

Deaf age groups separated by one year were relatively similar at D(22)-D(31):CA 11-12 in the distribution of performances into Piaget stages. From D(12) to D(21):CA 8-9, there were shown a substantial decrease in performances below Stage I and a substantial increase in performances at Stage I, although the distributions did not diverge significantly.

Hearing and Deaf. Hearing and deaf subjects at the same age levels could be compared only at CA 8, 9, and 11. At these age levels the percentages of conservation responses (Stage III) of the hearing and deaf were similar at CA 8, but at CA 9 and CA 11 those of the hearing were considerably higher than those of the deaf. On this task, 100% of the

D(32):CA 14 responses were at Stage III. The lowest percentage of conservation responses of any deaf age group (D(12):CA 8) was approximately four times greater than the 8.3% of the H(11):CA 6 group.

While in each of the three comparisons possible across a three-year span -- CA 8-11, CA 9-12, and CA 11-14 -- the distributions shifted toward a greater proportion of performances at the higher stages; only the distributions for D(22)-D(31):CA 11-14 diverged significantly (chi square = 12.11, 2 df).

The distributions into Piaget stages for the residential and day school deaf were similar at all five age levels tested, and neither subgroup consistently exhibited a higher level of understanding of the concept.

Hearing subjects at the same ages as deaf subjects tended to better understand conservation of number, but only on the CA 9 comparison did the distributions into Piaget stages diverge significantly (chi square = 12.89, 2 df). Comparisons of hearing and deaf at different ages showed the most similar distributions for D(22):CA 11 and H(21): CA 9. The D(32):CA 14 group was at a higher level of understanding than all hearing groups tested (CA 6, 8, 9, 11). The distribution attained by the deaf at CA 14 diverged significantly from that of the CA 9 and younger hearing groups (chi square = 12.61 and higher, 2 df). The H(11): CA 6 group had a lower level of understanding of conservation than all deaf groups tested (CA 8, 9, 11, 12, 14), and in all instances except in the comparison with the CA 9 deaf, the divergence of distributions into stages was significant (chi square = 14.19 and higher, 2 and 3 df).

All performances of hearing subjects could be classified into Piaget Stages I, II, and III. For the D(12):CA 8 group, 29.4% of performances were below Stage I, but all performances by older deaf age groups

tested could be classified into one of the Piaget stages.

Quantitative Scores. In Table A-V-6 are presented data on the mean quantitative conservation of number scores and t values for selected comparisons. This table shows a consistent increase in mean quantitative scores for both hearing and deaf from younger to older age groups. Between CA 6 and CA 8 for the hearing, the mean score increased from 2.30 to 3.65, but after this age the increments were smaller and the mean score at H(22):CA 11 was 3.88. For the deaf, large increases in mean scores occurred between consecutive age levels beyond CA 9; but between CA 8 and CA 9 the increase was only .07.

Analyses of the significance of differences of the mean quantitative scores for the hearing and deaf, on the whole, agreed with those based on the distributions of the performances into Piaget Stages. The few variations found occurred when comparisons involving CA 6 or CA 8 were made: i.e., CA 8 hearing scored significantly higher than CA 8 deaf ($t = 2.95$); the deaf at CA 11, CA 9, and CA 8 did not differ significantly from the younger hearing.

Analyses based on quantiative scores agreed with those based on classification of performances into Piaget stages as follows: significant differences in longitudinal comparisons were found only for the H(1) and the D(3) comparisons ($t = 4.03$ and 2.75, respectively). On cross-sectional comparisons no significant differences were found between age groups separated by one year for either the hearing or the deaf. In comparisons over three years, significant differences were found between the H(11)-H(21): CA 6-9 and D(22)-D(32):CA 11-14 groups ($t = 4.35$ and 2.76 respectively). Comparisons between hearing and deaf at the same ages found the mean score of the hearing to be significantly higher at CA 9 ($t = 2.86$) but not at CA 11. In comparisons between hearing and deaf at different ages, the mean score of the D(32):CA 14 did not dif-

fer from that of H(22):CA 11, but it was significantly higher than that of H(21):CA 9 ($\underline{t}$ = 3.23); the mean score obtained by D(31):CA 12 did not differ significantly from that of the hearing at CA 11, CA 9, or CA 8, but was significantly higher than that of H(11):CA 6 ($\underline{t}$ = 3.18); the mean score of the hearing was not significantly higher than that of the deaf at CA 11, but was at CA 9 (t = 2.86). No differences were found between hearing boys and girls and between deaf boys and girls. Resident and day school deaf did not differ significantly at any of the age levels tested.

Summary. The concept of the conservation of number was attained by practically all hearing children at CA 11 and by all deaf children at CA 14.

Analyses of the level of understanding of the concept based on classifivation into Piaget stages and quantitative scores agreed essentially. In longitudinal comparisons, the levels of understanding of the concept increased between testings for both hearing and deaf. Significant increments were made by the hearing between CA 6 and CA 8, and by the deaf between CA 12 and CA 14.

In cross-sectional comparisons within the hearing sample, no significant differences occurred between age groups separated by one year; in comparisons between groups separated by three years, only that between CA 6 and CA 9 was significant. For the deaf, too, no differences occurred between age groups separated by one year; only the comparison between CA 11 and CA 14 was significant among those made over a three-year span.

In comparisons between hearing and deaf, the hearing exceeded the performances of the deaf significantly at the younger ages, but not at the older ages tested. Deaf children at all ages tested exceeded the

performance of the CA 6 hearing.

Boys and girls did not differ in their performances in either the hearing or deaf samples. Resident and day school deaf did not differ in their performances.

Conservation of Substance

Tables A-V-7 and A-V-8 present the distributions by number and per cent of the classifications into Piaget stages for the hearing and deaf. Table A-V-9 presents relevant data on quantitative scores.

First and Second Testing Session Comparisons: Piaget Stages

Hearing. All three hearing groups increased in frequency of conservation (Stage III) responses from the first to the second testing. The largest increment occurred for the H(1) group--from 8.3% to 66.7%. For the older groups, the increments occurred within the higher limits possible. Thus, the percentage of Stage III responses increased from 75% to 83.3% for H(2) and from 83.3% to 100% for H(3).

The level of understanding of conservation (based on the distribution of performances into Piaget stages) shifted upward between testings for all groups, although the distributions differed significantly only for the H(1) group (chi square = 33.40, 2 *df*). Aside from the increases in Stage III responses, this upward shift was most evident in the decrease of Stage I responses for the H(1) group from 58.3% to 4.2% and for H(2) from 12.5% to none, and in the decrease of Stage II responses for the H(3) group from 16.7% to none.

Deaf. Performance of the deaf subjects on the Conservation of Substance task was consistently at a low level. Conservation (Stage III) responses increased from none to 10.5% between testings for D(2), and

remained constant at 25% for D(3) at both testings.

The level of understanding, as indicated by the distribution of performances into the several Piaget stages, emphasized the low level of performance, and showed shifts toward better understanding of conservation of substance primarily at the lower classifications of performance. For neither the D(2) nor D(3) group were the distributions at the two testings significantly divergent. Between testings of the D(2) group the percentage of performances that was below Stage I decreased from 47.4% to 21.1%; that in Stage I increased slightly from 52.6% to 57.9%; and those in both Stage II and Stage III increased from none to 10.5%. Between the two testings of the D(3) group the percentage of performances that was below Stage I decreased from 12.5% to none; that in Stage I increased from 45% to 62.5%; that in Stage II decreased slightly from 16.7% to 12.5%, and that at Stage III remained constant at 25%.

Sex Comparisons with Age Groups: Piaget Stages

Hearing. The level of understanding of the concept of conservation attained by hearing boys and girls at all six age levels was similar. The number of conservation responses was also similar, except at one age level: approximately twice as many H(12):CA 8 girls gave Stage III responses as H(12):CA 8 boys.

Deaf. At the five age levels tested, the level of understanding of conservation attained by deaf boys and girls did not diverge. Except that D(32):CA 14 boys gave somewhat more Stage III responses, the sexes were similar in the number of such conservation responses.

Age Comparisons: Piaget Stages

Hearing. After CA 6, the hearing performed at a relatively high level on the Conservation of Substance Task. At H(12):CA 8 and all older ages, Stage III accounted for a minimum of 66.7% of the perfor-

mances. At CA 14 all the performances were classified at Stage III.

Level of understanding, as indicated by the several Piaget stage distributions, of the hearing age groups separated by one year (CA 8-9 and CA 11-12) were similar; those at CA 11 and CA 12 were identical 16.7% and 83.3%, respectively. Distributions into Piaget stages of age groups separated by three years, CA 8-11, CA 9-12, and CA 11-14, were for the most part similar: Only the distributions of the H(11):CA 6 and the H(21):CA 9 groups diverged significantly (chi square = 22.20, 2 df).

Deaf. The performances of the deaf were low on the Conservation of Substance Task throughout the age range tested. Few deaf children at any age level gave conservation (Stage III) responses.

The distributions of performance into the several Piaget stages emphasized the lack of understanding of the concept. For the D(12):CA 8 age group, 76.5% of the performances were below Stage I. At D(32): CA 14, the oldest age group tested, all performances could be classified into a Piaget stage, but 62.5% were still at Stage I and only 25% at Stage III.

The distributions of performances of deaf age groups separated by one year--D(21)-D(22):CA 8-9 and D(22)-D(31):CA 11-12--did not diverge significantly. Despite the low level of performances, in deaf age groups separated by three years the older age groups performed at a higher level. Comparisons found that distributions of the D(12)-D(22): CA 8-11 and the D(21)-D(31):CA 9-12 age groups did diverge significantly (chi square = 12.05 and 12.64, 3 df, respectively).

Performances of the day and resident school subgroups were similar at all age levels tested.

Hearing and Deaf. Performance of the deaf was very inferior to

that of the same aged hearing at all five age levels on which comparisons were possible--CA 8, 9, 11,12, and 14. The smallest chi square obtained in comparing similar age groups was 28.80 (2 and 3 df). Examination of the distributions into Piaget stages gives a clear idea of the extent of the inferiority of the deaf. For the hearing all performances at any age could be classified into a Piaget stage. For the deaf 76.5% of the performances at CA 8 were classified below Stage I. While the percentage of such performance decreased from age to age, 12.5% were still below Stage I at CA 12, and only at CA 14 could all performances be classified into the Piaget stages. For the hearing, the percentage of Stage I performances increased throughout the age range tested, reaching 62.5% of the performances at CA 14. The percentage of Stage III performances attained by the D(32):CA 14 was smaller than that attained by all hearing groups except H(11):CA 6.

The only distributions into Piaget stages of the performances of the hearing that did not diverge significantly from these of the deaf were in comparisons of H(11)-D(32):CA 6-14, and D(31)-D(22):CA 12-11 groups. All comparisons of the distributions of performance of the deaf at CA 14, 12, and 11 showed them to be significantly inferior to the hearing at CA 8 and older; all comparisons of the deaf at CA 8 and 9 showed them to be significantly inferior to the hearing at the same age levels and younger (the lowest chi-square obtained was 16.70, 2 and 3 df).

Quantitative Scores. The mean quantitative conservation of Substance scores (see Table A-V-9) emphasize the inferior level of performance and the different pattern of change in scores for the deaf as compared with the hearing. Over the age range studied, the scores for the hearing showed substantial changes between H(11):CA 6 and H(12):

CA 8 (from 2.27 to 5.27), and somewhat irregular and gradual changes with increasing age until at H(32):CA 14, the mean score was 6.00, the maximum possible. The mean scores for the deaf were very much lower: that of the H(11):CA 6 group fell between the means of the D(31):CA 12 and D(32):CA 14 groups at 2.33 and 2.13, respectively. The increase in magnitude of mean scores with age was irregular for the deaf. The largest change, from 0.88 to 2.33 occurred between the D(22):CA 11 and D(31): CA 12 age groups.

Analyses of the significance of differences between mean scores substantiated the classification of performances into Piaget stages. In the longitudinal comparisons within both hearing and deaf samples, only H(1) showed a significant increase from the first to the second testing ($\underline{t}$ = 5.11). Within the hearing and deaf samples, no significant differences occurred between age groups separated by one year. When age groups separated by three years were compared, the differences in mean quantitative conservation of substance scores were significant between H(11)-H(21):CA 6-9 and D(21)-D(31):CA 9-12 ($\underline{t}$ = 5.39 and 3.11, respectively).

Comparisons between hearing and deaf age groups found the hearing obtaining significantly higher mean scores than the deaf of the same age at CA 8, 9, 11, 12, and 14 ($\underline{t}$ values ranged from 5.62 to 13.18). The mean score of H(11):CA 6 did not differ significantly from the mean scores of the deaf at CA 14, 12, and 11. In all other comparisons between the deaf and younger hearing age groups the mean scores obtained were significantly different.

<u>Summary</u>. The deaf are very inferior to the hearing on the Conservation of Substance Task. In the percentage of conservation (Stage III) responses, the CA 11 deaf were similar to the CA 6 hearing. The CA 12

and CA 14 deaf offered somewhat more conservation responses than the CA 6 hearing, but still were closer to this hearing age group than to any other.

In the level of understanding of conservation of substance, the deaf at CA 11, 12, and 14 did not differ from the CA 6 hearing, and the deaf at CA 8 and 9 were significantly below the hearing at CA 6.

In longitudinal comparisons, only the youngest hearing improved significantly between testings. Neither hearing nor deaf age groups separated by one year differed in performances. In comparisons over three years the hearing differed significantly between CA 6-9 and the deaf between older ages. However, it should be noted that the hearing at the middle and oldest ages understand conservation while the deaf do not. Analyses based on classification of performances into Piaget stages and quantitative scores agree.

Conservation of Weight

Distributions of performances into Piaget stages on the Conservation of Weight Task for hearing and deaf age groups are presented in Tables A-V-10 and A-V-11. Quantitative scores and _t_ values for selected comparisons appear in Table A-V-12.

First and Second Testing Session Comparisons: Piaget Stages

Hearing. The number of conservation (Stage III) responses increased substantially from Session I to Session II for all hearing groups: For the H(1) group the conservation responses increased from 4.2% to 62.5%; for H(2), from 33.3% to 75.0%; and for H(3), from 58.3% to 100%.

In the distributions of performances into Piaget stages, the H(1), H(2), and H(3) groups all showed substantial shifts toward better per-

formance from the first to the second session (chi square = 28.58, 13.84, 12.62, respectively, 2 df). Performances for the H(1) group decreased at Stage I from 83.3% to 8.3% and increased at Stage II from 12.5% to 29.2%. For the H(2) group, Stage I responses decreased from 41.7% to none, and Stage II performances remained constant at 25%. For the H(3) group, Stage I responses decreased from 16.7% to none, and Stage II responses decreased from 25% to none. Thus, it can be seen that the level of performance on the Conservation of Weight Task is quite high.

Deaf. The number of conservation (Stage III) responses given by the D(2) and D(3) groups increased substantially between testings, and at the second testing, the latter group gave a relatively high proportion of Stage III responses. From Session I to Session II, the D(2) group increased in Stage III responses from none to 21.1%; and the D(3) group, from 41.7% to 62.5%.

While both D(2) and D(3) shifted between testing sessions in their performances toward a better understanding of the conservation of weight, the distributions into Piaget stages did not diverge significantly. Although the D(2) group had 5.3% performances below Stage I at the first testing, none occurred at this level at the second testing two years later; the percentage of Stage I performances decreased from 52.6% to 42.1%; the percentage of Stage II performances decreased slightly from 42.1% to 36.8%; and the percentage of Stage III responses increased. Every performance of the D(3) group at both testings could be classified into a Piaget Stage. Between sessions, Stage I performances decreased from 16.7% to 4.2%, Stage II from 41.7% to 33.3%, and Stage III performances increased.

Sex Comparisons within Age Groups

Hearing. The performances of hearing boys and girls at the six age

levels tested were similar when both conservation (Stage III) responses and distributions of performances into Piaget stages were considered. Only the H(12) grils gave substantially more Stage III responses than the comparable boys.

Deaf. Deaf boys and girls at each of the five age levels tested were similar in the distributions of performances and in the number of conservation (Stage III) responses. Only the D(32) boys gave substantially more conservation responses than the comparable girls at any of the age levels tested.

Age Comparisons: Piaget Stages

Hearing. While the trend over the age range tested was definitely toward more conservation (Stage III) responses, the number of such responses was not consistently higher as the older ages were considered. Subjects at the second testing gave more conservation (Stage III) responses than those who were one year older at the first testing session, i.e., CA 8-9 and CA 11-12.

The general trend toward the better understanding of conservation was apparent in the distributions into Stages, but the changes with age were irregular. The greatest improvements in the distributions were found between the two youngest ages tested, H(11)-H(12):CA 6-8. However, in comparing the distributions of age groups separated by one year, the younger age group had the higher level of performance. This was particularly evident in the higher percentage of Stage I and the lower percentage of Stage III performances at CA 9 in the CA 8-9 comparison, and at CA 12 in the CA 11-12 comparison. While inspection of the distributions suggested differences in both comparisons, only in that between CA 8-9 could the null hypothesis be rejected at the .01 level (chi square = 13.84, 2 df).

When the distributions were compared over a three-year span, only those between H(11):CA 6 and H(21):CA 9 diverged at a significant level (chi square = 9.78, 2 df).

Deaf. Over the age range tested -- CA 8 to CA 14 -- the deaf showed a substantial increase in the number of conservation (Stage III) responses. At the two youngest ages tested, no conservation responses were given, but at the three oldest ages (CA 11, 12, and 14) conservation responses accounted for 21.1%, 41.75%, and 62.5%, respectively.

Considering the distributions of all performances, a high level of understanding was quite consistently attained by the older age groups. At the younger ages tested, however, the conservation of weight task was very difficult for the deaf. Thus, for D(12):CA 8 it was not possible to classify 35.3% of responses into a Piaget stage, and at the three youngest ages tested, Stage I responses were most frequent. However, the proportion of Stage I responses decreased greatly over the age span and that of Stage III increased until it included nearly two-thirds of the performances at CA 14. The progressions of classifications into the Piaget stages with age were found in the expected directions with only one slight exception -- Stage II performances by the D(22):CA 11 group.

Although the understanding of conservation responses progressed toward a higher level, the distributions of age groups separated by one year -- CA 8-9 and CA 11-12 -- were quite similar.

Shifts in the distributions of groups separated by three years were substantial. However, while those between D(12)-D(22):CA 8-11 and D(21)-D(31):CA 9-12 diverged significantly (chi square = 13.33 and 11.65, 3 df), that between the D(11)-D(21):CA 6-9 was just below the level of significance.

The performances of the resident and day school deaf were quite similar at all ages tested regardless of whether conservation (Stage III) responses or distributions of performances into Piaget stages were considered.

Hearing and Deaf. At each age the number of conservation responses given by the deaf was considerably below that of the hearing. The differences in the percentage of conservation responses was 62.5% at CA 8, 33.3% at CA 9, 53.9% at CA 11, 16.6% at CA 12, and 37.5% at CA 14. The differences obtained at the second testing sessions for the hearing were larger than those obtained at the first testing session. For both first and second testing sessions, the differences in the percentage of conservation responses were smaller when older ages were compared. The percentage of conservation responses given by D(32):CA 14 was equal to that of H(12):CA 8 and approximated that of H(31):CA 12.

Examination of the distributions of Piaget stages indicated that the hearing had a higher level of understanding of conservation than the deaf at each of the five age levels for which comparisons were made. The extent to which the distributions into stages diverged varied from age to age: At the first testing sessions of CA 9 and CA 12, the divergence between the hearing and deaf was not of sufficient magnitude to reject the null hypothesis. However, at all ages that represented second testing sessions for the hearing, CA 8, CA 11, and CA 14, the null hypothesis was rejected at the .01 level of confidence (chi square = 11.08, 16.65, and 11.08, 2, 3 df).

In comparing the hearing and deaf subjects at the same age levels, it was noted that the pattern of differences in the number of conservation (Stage III) responses and the distribution of all performances into Piaget stages appeared to reflect the differences in the performances

of the hearing and the deaf at second testings. Younger hearing subjects at a second testing tended to perform at a higher level on the conservation of weight task than those a year older at a first testing session. However, younger deaf subjects tended to perform at a lower level than older deaf subjects regardless of whether the test session was the first or second.

The performance of the H(11):CA 6 group was inferior to that of the deaf at CA 9, CA 11, CA 12, and CA 14, and at the two older ages the superiority of the distributions of the deaf age groups was significant (chi square = 21.72 and 31.64, 2 df). However, the performance of H(11): CA 6 was significantly above that of D(12):CA 8 (chi square = 12.55, 3 df).

Quantitative Scores

The magnitude of the mean quantiative conservation of weight scores was irregular from age to age. At the second testing, younger hearing groups received higher mean scores than those one year older at the first testing. At H(12), H(22), and H(32), the three age groups tested the second time, the mean quantitative score was above 5 with 6 the maximum score (see Table A-V-12).

The mean quantitative conservation of weight scores for the deaf showed a steady increase from 1.13 for D(12):CA 8 to 5.26 for D(32): CA 14. It was apparent from the mean score obtained by the oldest group that deaf subjects were able to perform at a relatively high level on the conservation of weight task.

With only a few exceptions, comparisons of performances based on quantitative scores agreed with those based on classifications into Piaget stages. In the longitudinal comparisons, the H(1) and H(2) mean quantitative scores increased significantly from the first to the second

testing sessions (t = 7.28 and 3.78). Based on quantitative scores, the difference between testings for the H(3) group reached the .05 level, although when the comparison was based on classification of performance into stages, the two groups had been found to diverge significantly at the .01 level. The deaf increased in mean quantitative scores in the longitudinal comparisons but the increments were not significant.

In both the CA 8-9 and CA 11-12 comparisons between hearing age groups separated by one year, the younger groups received the higher mean scores; in the CA 8-9 comparison the difference was significant (t = 3.15). In comparable comparisons for the deaf, higher mean scores were obtained by the older age groups at a nonsignificant level.

No comparisons made over a three-year span for the hearing were significant, but for the deaf the mean scores between CA 8-11, CA 9-12, and CA 11-14 differed significantly (t values were 2.92 and above). The performances of H(11)-H(21):CA 6-9 differed at the .05 level (t = 2.60) when the comparison was based on quantitative scores, but at the .01 level when it was based on classification into Piaget Stages.

The hearing consistently obtained a higher mean score than the deaf at the same age. At (12):CA 8 and (22):CA 11, two age levels representing the second testing for the hearing, the differences were significant. At one second testing, (32):CA 14, the .05 level of confidence was reached (t = 8.29, 4.44, and 2.60, respectively); distributions of classifications into Piaget stages, however, diverged at the .01 level. The mean quantitative scores at (21):CA 9 and (31):CA 12, both representing the first testing sessions did not differ significantly.

The deaf at all ages except CA 8 obtained higher mean scores than H(11):CA 6, although the differences reached significant levels only between the 6-year-old hearing and D(32):CA 14 and D(31):CA 12 (t = 6.60,

4.14). The H(12):CA 8 group received significantly higher mean quantitative scores than the deaf at CA 12, CA 11, and CA 9. Similar comparisons based on classification of performances into Piaget stages between H(12):CA 8 and the different deaf age groups, found the distributions to diverge only for the H(12):CA 8-D(21):CA 9 comparison.

Discussion

The conservation of weight has been previously investigated by Oleron and Herren (1961) and by Furth (1964). Results of these two studies--published after this study was begun--do not agree.

Subjects in the Oleron and Herren study were 58 profoundly deaf children divided into five age groups between 12 and 16 years, and 66 hearing boys divided into six age groups between 6 and 12 years. The mean CA of the deaf was 14.6 years and that of the hearing, 8.6. The deaf came from special classes and were of normal intelligence, as determined by a nonverbal test. The authors used techniques described by Piaget with certain modifications to eliminate the use of language. A series of three pictures representing equal weight, heavier weight on the right, and on the left side were used in order to do away with the necessity for language. Four phases of a trial learning period preceeding the experiment were devised to affirm that the subject understood differences and similarity in weight as related to the pictures. In these, by means of mimicry and gestures, the child was asked to distinguish between two heavy and one light piece of dough, and then to manipulate a real scale and to chose the corresponding picture. If the response was correct, the scale was covered with a screen and the child was asked to interpret the demonstration of different weights in relation to the pictures. In the experimental procedure the form of the clay was modified into a sausage, a ring, etc., and divided into two

and eight pieces. The number of transformations was not fixed; sometimes there were as many as 12. A subject was judged to have the concept of conservation if he had responded correctly to all presentations of the stimuli. However, an error, which in view of the subject's other responses could be considered accidental, was not counted. Fifty per cent of both the entire deaf sample and the entire hearing sample gave conservation responses. Thus the deaf children, as a group, manifested an inferiority of about six years in comparison with hearing children. Although the number of subjects at the separate age levels was not large, in general, comparisons between specific ages confirmed the inferiority of the deaf at five or six years.

Furth (1964) in replicating the Oleron and Herren study modified the testing procedure to eliminate both the necessity for verbalization and the use of pictures. In an initial training session weights with the number of ounces (from 1 to 16) written on them were presented to the subject in pairs of equal or unequal weights. In a systematized procedure the subject was taught to keep his hands level if the weights were the same, to lower the hand holding the heavier weight and to raise the hand holding the lighter weight. After the subject had showed in six consecutive trials that he understood the instructions he used the same gestures in trials with clay balls. Then only subjects who succeeded without hesitation on six trials with the clay balls were given the experimental procedure in which, in 13 predetermined trials, the balls, or the objects into which they had been transformed were handed the child. Three trials were considered essential for the principle of conservation: One ball, one snake; one ball, one ring; and one disc, one ring. The subject was not corrected and was considered to have failed if he consistently gave a wrong response on these three trials.

In reporting success and failure, spontaneous corrections and hesitations by the subjects were noted. The 22 deaf subjects were the entire sample of eight-year-olds in a state school for the deaf (mean CA, 8 years, 5 months). Hearing subjects were 19 six-year-olds in first grade (mean CA, 6 years, 10 months), and 10 eight-year-olds in second grade (mean CA, 8 years, 2 months). Furth found that 45.4% of the deaf children, 90% of the eight-year-old hearing, and 41.1% of the six-year-old hearing satisfied the criterion of success. Thus the deaf were about 1.5 years inferior to the hearing. Six-year-old hearing girls had more conservation responses than boys but no comparable sex difference was found for the deaf. The deaf children made more hesitant failures. If these had been included with successes, the differences in the performances of eight-year-old deaf and hearing subjects would not have been reliably different.

The ages at which deaf subjects in the present study reached a given percentage of conservation (Stage III) responses was only slightly younger than that reported by Oleron. Thus, conservation responses were given by about one-fourth of the CA 12.7 subjects in Oleron's study and of the CA 11 subjects in this study; by about 40% of the 14.4 year-old subjects in Oleron's study and the CA 12 age group in this study; by about two-thirds of Oleron's 15.4 year olds, and the CA 14 age group in this study. On the other hand, the subjects in the present study gave many fewer conservation responses than those in the study by Furth. The percentage of conservation responses by the CA 12 in the present study was similar to that of the CA 8 deaf in Furth's study.

Such differences in results must be faced, and, if possible, explained. Explanations can be sought primarily in differences in scoring and administrative procedures. Scoring techniques are not spelled

out in detail either in the Oleron or the Furth report. From the general description given, it is not likely that a successful performance in either of the studies and in the present one would differ greatly. It is possible, however, that the criteria in the present study were more stringent because of the emphasis on explanation of observed or predicted phenomena.

Although in this study no systematic attempt was made to eliminate verbal interchange in the administration of the task, consistent emphasis was placed on the objective determination of the subject's communication of "heavier", "lighter," and "same." Most subjects indicated a heavier weight by lowering one hand, a lighter weight by raising one hand, and the equality of weights by keeping the hands in the same place, although they were not systematically taught this method of communication. In this study (and in that of Oleron) a balance was present during at least part of the administration of the task. While in this study subjects were not prohibited from weighing the clay in their hands, they were not encouraged to do so. They did not do so systematically. Thus, for the most subjects, the kinesthetic cues that were built into Furth's administrative procedure were not present. Even when the kinesthetic cues were present, they were always incidental to the question of similarity or difference in the weight of clay presented in several transformations. Oleron used his pictures designed to eliminate the necessity for verbalization in relation to the balance and thus attention was objectively centered on weight. It may be possible that by systematically having the subjects handle the clay, Furth emphasized the kinesthetic rather than the cognitive aspect of the conservation of weight task.

Deaf subjects in this study progressed regularly in the proportion

of conservation of weight responses with increasingly older age groups. The hearing subjects, however, were extremely irregular in performance related to age. In all instances a much higher proportion of hearing subjects gave conservation responses at the second session, regardless of age. On the whole, the percentage of conservation responses given by hearing subjects at the second testing was more similar to that reported by other investigators than that given by subjects at the initial testing (Elkind, 1961; Furth, 1964; Lovell and Ogilvie, 1961; Oleron and Herren, 1961).

When comparisons were made between the deaf and the hearing at the initial testing in this study the inferiority of the CA 14 and CA 12 deaf was about two years and that of the CA 11 deaf between two and five years. When comparison was made with those hearing age groups representing the second testing, however, the performances of the CA 14 deaf was similar to those of the CA 8 hearing, i.e., about six years inferior. If comparisons were made between the performances of the deaf and hearing as reported by other investigators, the number of years of inferiority to the hearing is more consistently at the larger figure.

Conservation of Volume

Distributions of performance of hearing and deaf into Piaget stages are given in Tables A-V-13 and A-V-14.

First and Second Testing Session Comparisons: Piaget Stages

Hearing. From the first to the second testing session the number of conservation (Stage III) responses increased for the H(1) and the H(2) but not for the H(3) groups. Conservation responses were very infrequent for the two younger groups. They increased from 4.2% to 12.5%

for the H(1) and from 8.3% to 16.7% for the H(2) groups. Although conservation responses were more frequent for the H(3) groups, still only 45.8% at Session I and 41.7% at Session II were classified at Stage III.

Distributions of performance into Piaget stages were examined to determine the general level of understanding of conservation of volume. Despite a persistent low level of understanding, the H(1) group shifted substantially toward a better understanding of the concept from Session I to Session II (chi square = 34.84, 2 df). The major shifts occurred in Stage I and Stage II responses. At the first testing session, 87.5% and 8.3%, respectively were classified in the two stages, but at the second testing session, the performances had shifted to 4.2% and 83.3%, respectively.

Distributions of responses by stages remained quite similar from the first to the second session for the H(2) and the H(3) groups, although the level of understanding of the older group was higher than that of the younger. For the H(2) group, 75% and 70.8% of the performances at the two testing sessions were classified at Stage II. For the H(3) group, 50% and 58.3% were classified at Stage II and 45.8% and 41.7% at Stage III, at the first and second testing sessions, respectively.

Deaf. Very few conservation of volume (Stage III) responses were given by the deaf. None were given by D(2) at Session I and only one at Session II; five were given by D(3) at the first and three at the second testing session. Thus, D(2) can be considered to have not given conservation responses at either testing. For the D(3) group, conservation responses were not only infrequent but tended to decrease in frequency from 20.8% to 12.5%.

Although understanding of conservation as evidenced by classification of performance into Piaget stages was consistently at a very low

level, both the D(2) and D(3) groups improved slightly from the first to the second session. The greatest shift for D(2) was the decline from 47.4% to 21.1% in performances that were below Stage I. The greatest shift for D(3), however, was the increase in Stage II responses from 37.5% to 75%. Only for the D(32):CA 14 could all performances be classified into a Piaget stage.

Sex Comparisons within Age Groups: Piaget Stages

Hearing. Hearing boys and girls differed in neither the number of conservation (Stage III) responses or in the level of understanding of conservation of volume as evidenced in the distributions into Piaget stages. Only in the H(32):CA 14 group did the sexes differ in the number of Stage III responses.

Deaf. Distributions of performances of deaf boys and girls classified into Piaget stages were similar at the five age levels tested. The number of Stage III responses was very low, and neither sex seemed to give more of them.

Age Comparisons: Piaget Stages

Hearing. Although over the entire age range tested both the number of conservation (Stage III) responses and the level of understanding of conservation improved, the task was difficult for all age groups. At no age were as many as half of the performances classified as conservation (Stage III) responses -- the highest percentage, 45.8%, occurred at H(31):CA 12. At every age tested, however, at least one performance could be classified at Stage III.

The greatest change in level of understanding of conservation occurred between CA 6 and CA 8. At H(11):CA 6, 87.5% of the performances were classified at Stage I. At ages from CA 8 through CA 14 responses at Stage II were most frequent and accounted for between 50% and 91.7%

of the performances.

Distributions of performances of hearing subjects separated by one year did not diverge significantly. In the CA 8 to CA 9 comparison, the older age group was at a slightly lower level of understanding; but in the CA 11 to CA 12 comparison the older age group was at a higher level.

Across a three-year span, all distributions at the older ages showed a better understanding of the conservation of volume than the younger ages. The only comparison in which distributions diverged significantly, however, was that between H(11)-H(21):CA 6-9 (chi square = 24.70, 2 df).

Deaf. The Conservation of Volume Task was too difficult for deaf subjects. This difficulty is probably best seen in the few conservation (Stage III) responses that occurred and in the fact that only at D(32): CA 14 could all performances of deaf subjects be classified into any Piaget stage. The percentage of performances that were below Stage I became consistently smaller as the older age levels were considered - from 82.4% at D(12):CA 8, to 4.2% at D(31):CA 12, to none at D(32):CA 14. The number of such performances means that the examiner could not be certain that the subject had any idea of the problem at hand. It was the most common classification at CA 8 and CA 9. Stage I was the most frequent classification at D(22):CA 11 (47.4%); Stage I and Stage II were equally frequent at D(31):CA 12, with 37.5%; and Stage II at D(32): CA 14 with 75%.

Distributions of classifications for the deaf separated by one year were quite similar, but in both the CA 8-9 and CA 11-12 comparisons the older age group exhibited a slightly higher level of understanding. When comparisons were made over a span of three years, in all instances the older age group was at a higher level of understanding, and the dis-

tributions of responses into stages diverged significantly in the CA 8-11 and CA 9-12 comparisons (chi square = 15.53 and 13.48, 2 df, respectively).

The residential and the day school deaf performed in a similar manner at each age level tested.

Hearing and Deaf. At all ages the hearing performed at a higher level than the deaf of the same age. The deaf at CA 12 and CA 14 gave about as many conservation (Stage III) responses as the hearing at CA 11 and younger. However, it was only at the older hearing ages that any substantial number of responses could be classified as conservation (Stage III) responses.

When the distribution into stages was considered, the D(32):CA 14 most nearly resembled the H(22):CA 11 or the H(12):CA 8. Although the understanding of the concept of conservation of volume by the deaf at CA 12 and CA 14 was below that of hearing subjects at the same age, it was significantly better than that of the H(12):CA 8 and H(11):CA 6 (chi square = 27.30 or higher, 2 df). Not until 12 and 14 years did the hearing begin to give a substantial number of conservation (Stage III) responses. The deaf at these ages did not show a similar spurt and the distributions of their responses into Piaget stages were more similar to that of younger hearing children. Thus it is apparent that the younger hearing and all deaf subjects did not understand the concept of conservation of volume.

Discussion of Conservation Tasks

The deaf were inferior to the hearing on all conservation tasks. In general, the deaf showed a pattern of more conservation responses at

higher age levels regardless of whether a first or second testing session was considered. For the most part, this was also true for the hearing, except that in the Conservation of Weight Task younger subjects on a second testing gave more conservation responses than older subjects at an initial testing. Thus, on this task the hearing profited from previous exposure to the testing situation. While the reasons for this finding are not known, they may be related to the readiness of subjects to develop a particular type of conservation.

The conservation tasks used in this study have been previously considered by a number of investigators. Piaget has asserted that attainment of conservation of number, substance, weight, and volume follow each other in this sequential order (Piaget and Inhelder 1941; Piaget 1950). Validation studies such as those by Elkind (1961a; 1961b; 1961c) support the sequence. In Table 5.1 are presented the percentage of conservation (Stage III) responses given by the hearing and the deaf age groups in this study.

Table 5.1. Percentage of Conservation (Stage III) Responses on Number, Substance, Weight, and Volume Tasks by Hearing and Deaf Age Groups.

GROUP: CA:	(11) 6	(12) 8	(21) 9	(22) 11	(31) 12	(32) 14
HEARING						
Number	8.3	33.3	58.3	83.3	--	--
Substance	8.3	66.7	75.0	83.3	83.3	100.0
Weight	4.2	62.5	33.3	75.0	58.3	100.0
Volume	4.2	12.5	8.3	16.7	45.8	41.7
DEAF						
Number	--	35.3	26.3	57.9	54.2	100.0
Substance	--	0.0	0.0	10.5	25.0	25.0
Weight	--	0.0	0.0	21.1	41.7	62.5
Volume	--	0.0	0.0	5.3	20.8	12.5

For the hearing the sequential order of attainment of conservation of the several tasks was maintained, although the subjects in this study tended to achieve the 75% level of conservation responses at somewhat later ages than usually reported. It may be, of course, that the sample in this study was actually at a lower level of conservation. Since considerable variability in the percentage of conservation attained at various ages is reported in other studies it may be that these results reflect differences in testing procedures, scoring techniques, and/or experiences of subjects.

For the deaf in this study, however, the expected sequential order of conservation in the several tasks was not found. The proportions of conservation of substance and weight were reversed, so that the order of conservation for the deaf was: number, weight, substance, volume. The proportion of conservation responses attained by the oldest deaf was not high except for the conservation of number. However, the proportion of conservation responses found on the weight task (nearly two-thirds) was definitely above that for substance (about one-fourth). The conservation of volume was too difficult for most of the CA 14 deaf.

The different sequential order of types of conservation for the deaf may, of course, represent a real difference in cognitive functioning or it may be an indication of some of the unsolved, knotty problems associated with testing the deaf in tasks such as these. The relevance of the specific testing procedures to results obtained was aptly illustrated in the variant findings reported on the conservation of weight by Oleron and Herren, Furth and the present study. As the Conservation of Weight Task was administered to the deaf, it probably focused on the problem at hand more directly than did the Conservation of Substance Task, and thus may tap the capability of deaf subjects more adequately.

The presence of the scale, the opportunity to test predictions and hunches by the use of the scale, and the chance to handle the clay may serve more objectively to direct the deaf to the problem of the conservation of weight. Conversely, procedures in the administration of the Conservation of Substance Task were less specific and less objective. The attempt to convey the idea of a greater or a lesser amount of substance -- the idea of "more" or "less" -- unrelated to weight or to manipulation by the subject, made the very nature of the testing situation for conservation of substance quite subjective and/or abstract. Since the deaf are known to have difficulties in dealing with abstractions (Templin, 1954a; 1954b; 1950) the poor performance of the Conservation of Substance Task may be related to the greater ambiguity and less objectivity in the testing situation.

In this study, as in most others on conservation, "no information is presented regarding the invariance of this (sequential) order within individual subjects, i.e., how many subjects, if any, appeared to have acquired these conservations in a sequence other than the 'normal' one" (Flavell, 1963, p. 385). Data obtained should be analyzed to determine the sequence of achievement of the several types of conservation by individual children and the types of explanations offered by both deaf and hearing.

Although it was possible to obtain classificable responses from profoundly deaf children through the use of the Piaget interview technique with minimum modifications (see Chapter III), one has somewhat less confidence in interpreting responses of the deaf than of the hearing. Although Oleron and Furth attempted to eliminate the use of verbalization in their study of conservation of weight, this was not done in the present study since explanations were considered an integral part of the

communication of understanding of conservation. It was, however, extremely difficult to get the deaf children in this study to predict. The tendency was for them to report what they observed in the demonstrations in the testing situations. Explanations were infrequently offered, and, when given were usually meager and often somewhat ambiguous. Nevertheless, there were instances in which the deaf children gave about as good explanations as hearing children of the same age, even though the specific vocabulary might be considered inadequate. For example, one deaf boy who did not know the word "displacement" wrote in an explanation of why water rose when the clay ball was put into it, "The clay is in the water. The water did not go in this clay. The water goes up."

The clinical interview method of Piaget demands probing and questioning that increases as the subject's responses become more adequate. Children, and especially deaf children, are prone to expect approval for satisfactory intellectual performance. In the clinical interview technique used, however, the child is never told that he is or is not giving a correct answer, he is not praised or encouraged for successful performance, but rather for continuing to try and for supporting his position. Thus, more questioning follows tentative predictions and understanding. This technique is particularly difficult for use with the deaf, not only because of the pressure for prediction and explanation, but also because it tends, unfortunately, to be unfamiliar or, even in some instances, probably contrary to previous experience.

The quantitative conservation scores as developed in this study are neither independent of classification into Piaget stages nor indicators of the understanding of conservation. However, if the reationale underlying the quantitative score is accepted, the analyses of such scores in this study indicates that further investigation of them is warranted.

VI. RESULTS: VOCABULARY MEASURES

Multiple Meaning of Words (Watts)

The "Americanized" version of the Watts Multiple Meaning of Words test was given to the H(21), H(22), H(31), and H(32) groups. The maximum score was 40. The revision for the deaf, with a maximum score of 15 was given to the D(31), D(32), and D(22) age groups. Total mean scores and selected *t* values are given in Table A-VI-1.

First and Second Testing Session Comparisons

Hearing. Mean scores increased from the first to second testing sessions for both the H(2) and H(3) groups, but the increments were not statistically significant. The mean scores increased from about 40 per cent, of the possible score, for the H(21) to about 45 per cent for the H(22) group. The increase in scores was from 55 per cent for the H(31) to 65 per cent for the H(32) group.

Deaf. The scores for the D(31) and D(32) groups showed only a slight, non significant increase. The mean scores at both sessions were low; they increased from about 20 per cent of the possible score at D(31) to 25 per cent at D(32).

Sex Comparisons within Age Groups

Hearing. There was no significant difference in the performances of hearing boys and girls of the same age. On three of the four age comparisons, girls scored higher than boys.

Deaf. Deaf boys and girls did not perform significantly differently at the same age groups. On all the comparisons, the boys received the higher scores.

Age Comparisons

Hearing. Mean scores on all groups separated by three or more years were statistically significant (Table A-VI-1). Hearing groups separated by two or less years did not score significantly different.

The scores of the subjects in this sample were equivalent to those of British children studied by Watts (1944, p. 284):

CA	11-12	12-13	13-14	14-15
Score	17	20	23	26

The definition of age is not identical, but in this study the H(22):CA 11 group scored 18, the H(31):CA 12 group scored 22, and the H(32):CA 14 group scored 26.

Deaf. No comparisons between any of the deaf age groups were statistically significant. One comparison was possible over a three-year age span: D(22)-D(32):CA 11-14.

No significant differences were found between the scores of the day and resident school deaf at the same ages (Table 6.1). The same low

Table 6.1. Multiple Meaning of Words. Mean Scores and Significance of the Differences between Subjects at the Same Age Groups Enrolled in Day and Resident Schools.

	DAY SCHOOL			RESIDENT SCHOOL			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
D(22)	6	3.67	2.07	10[1]	2.30	1.77	1.41
D(31)[2]	13	3.00	1.96	11	3.09	1.45	0.13
D(32)	12	3.67	1.87	10[2]	3.70	2.11	0.03

1 Three subjects not tested

2 One subject not tested

percentage scores that were found for the deaf as a whole are apparent, as well as the nonsignificant differences in scores with increasing age.

Hearing versus deaf. The scores of the hearing and deaf are not

directly comparable because of the different number of items in the tests used. The mean percentage of possible scores for the hearing and the deaf presented in Table 6.2 indicated that the performance of the deaf was extremely inferior to that of the hearing children at the same

Table 6.2. Multiple Meaning of Words. Percentage of Possible Score Obtained by Hearing and Deaf Subjects by Age Groups.

		HEARING			DEAF		
Age Group	CA	Boys	Girls	Total	Boys	Girls	Total
(21)	9	39.6	40.0	39.8	--	--	--
(22)	11	45.0	44.6	44.8	20.0	17.1	18.7
(31)	12	52.1	57.9	55.0	21.8	17.7	20.3
(32)	14	64.0	66.3	65.1	26.7	21.5	24.5

age. The significance of the differences were not calculated, since it was obvious from inspection that the differences in the percentages were highly significant. The H(21):CA 9 subjects scored nearly 50 per cent higher than the D(31):CA 14 subjects. These two groups received the lowest scores for the hearing and the highest for the deaf age groups.

Specific Test Words

In Table 6.3 are given the percentages of correct responses for each test word by the hearing and deaf groups.

Table 6.3. Multiple Meaning of Words. Percentage of Correct Responses Per Word for Deaf and Hearing Age Groups.

	HEARING				DEAF	
	(21)	(22)	(31)	(32)	(22)	(32)
Word N:	24	24	24	24	N: 16	22
head	49.2	55.0	66.7	78.3	29.2	24.2
cross	43.3	53.3	61.7	68.3	27.1	36.4
roll	41.7	54.2	58.3	64.2	20.8	18.2
point	40.0	50.0	64.2	66.7	10.4	19.7
cover	37.5	40.8	50.8	66.7	14.6	24.2
round	36.7	45.8	50.8	60.8		
line	35.0	32.5	42.5	46.7		
run	24.2	25.8	43.3	53.3		

Hearing. From Table 6.3 it is readily seen that there was a steady increase in the percentage of correct responses for each word from younger to older hearing groups with only one minor reversion ("line" for H(22)). For age group H(21), the range of mean percentage of correct responses was between approximately one-fourth and one-half of the possible maximum; for age group H(32), it was between one-half and three-fourths of the possible correct responses. The rho between the percentage correct at the first and second testing session was very high for both the H(2) and the H(3) groups: .95 and .96 respectively (Table 6.4). The rank order intercorrelations among the various hearing groups are all at or above a rho of .88.

Table 6.4. Multiple Meaning of Words. Rank Order Correlations between the Number of Correct Responses Using Specific Words for Hearing and Deaf.[1]

	H(21)	H(22)	H(31)	H(32)	D(22)
H(22)	.95				
H(31)	.90	.88			
H(32)	.95	.88	.96		
D(22)	.90	.80	.40	.70	
D(32)	.95	.65	.33	.44	.48

[1] Intercorrelations for hearing based on 8 words. Intercorrelations for deaf and correlations between deaf and hearing based on 5 words common to both samples.

Deaf. From Table 6.3 it is seen that the percentage of correct responses for the five test words used with the deaf showed no systematic relation to age of subjects. Unlike the percentage scores for the hearing, there was no marked increase with age. The percentage of possible scores was low--only on one, "cross" for D(32) was the percentage above the lower one-third possible. From Table 6.4 it is seen that the correlation for the deaf age groups was only moderate between CA 11 and CA 14.

Hearing versus deaf. The great inferiority of the deaf is seen in that for none of the five test words common to both the deaf and the hearing did the percentages of correct responses of the oldest deaf, D(32):CA 14, even approach the percentages of the youngest hearing H(21): CA 9. Thus, in any age comparison (within the range considered) the deaf are below the performance of the hearing five years younger. The enormity of this inferiority is emphasized when it is recalled that only the words in the sentences best known by the hearing children were given the deaf. The rank order correlations between the hearing and deaf based on the five test words common to both are highest between H(21), the youngest hearing tested, and the deaf (Table 6.4).

Specific Sentences

The 15 sentences selected for the revision for the deaf were those in which the appropriate word was most frequently inserted correctly by the hearing.

From examination of the performances of the deaf subjects it is apparent that the deaf children learn to use words within rather narrow, specific contexts. None of the 16 subjects in the D(22) group was able to give a correct completion for the following test sentence:

"3. It was a treacherous thing to do under cover of friendship."

Only one correct completion was given for each of the following sentences:

"7. What was your point in asking such a question at that moment?"

"14. The young general was not expected to cover himself with glory in his first campaign."

"15. What do you think was the main point of his argument?"

Two correct responses were given to:

"11. The enemy's position was captured at the point of a bayonet."

All other sentences received three or more correct completions by the

D(22) group.

In the D(32) group the following two sentences were correctly completed by only two of the 24 subjects:

"9. The cowboys left the town and began to head for the open country."

"13. The roll of the drums sounded like distant thunder."

All other sentences received three or more correct completions.

The sentences most frequently completed correctly by the subjects in the deaf groups were the following:

"1. He gave the nail a blow on the head with his hammer."

"10. The child was tired and very cross."

These two sentences probably deal with experiences most familiar to the deaf children of any of the test sentences.

Of the 15 sentences, only 5 showed evidence of increasingly frequent completions with age. They were sentences (1), (3), (7), (10), and (14). All test words except "roll" are included in these sentences. The other sentences showed erratic changes or were static from age group to age group.

All test words were used in the sentences least frequently completed correctly, i.e. no single word accounted for any substantial proportion of sentences not completed.

Discussion

The words included in this Multiple Meanings Test are common words although it is likely that certain meanings of the words are more frequently encountered than others. However, underlying a test such as this is the premise that the various meanings of the words are within the experiences of the subjects.

One problem in the attempt to use a test of word knowledge previously

devised is that the words or the contexts in which they are used are not equally relevant to different samples or in different geographical areas, or at different periods of time. Templin (1958) found kindergarten children tested significantly lower on a range of information test 26 years after its construction than kindergarten children tested at the time of the construction of the test. She interpreted this to show that the children at the later period were not less knowledgeable but that the test did not sample their experiences. However, it seems that the words and sentences used in the present study were satisfactory in that they tapped the experiences of the hearing sample.

If a measure such as this can be interpreted as sampling the specific environment of the subjects, then there is substantial evidence that the hearing subjects in this study have comparable experiences. The high intercorrelations and test-retest correlations of the rank order of difficulty of the specific words indicates this. Individual children seem to have learned a number of different meanings for the same words, and they have learned to know them quite consistently and thoroughly. The increase in the level of their knowledge is not rapid, but it is regular and continuous. Steady increments in scores are noted and the increments made over a span of three years or more are all significant.

None of this holds true for the deaf. Their performance is extremely below that of the hearing within the same age range. The deaf show very little improvement in their performance with increasing age for the ages tested. There is no steady increment in the percentage of correct meanings of specific words from age to age. The scores of subjects separated by three years are not significantly different. There is only a moderate test-retest correlation. The performance of the deaf

at all age groups tested, most nearly resemble that of the youngest hearing. Not only have the deaf children not learned as many meanings of the common test words, but they do not "know" the meanings as thoroughly or consistently. Results suggest that the extent of common experience within the deaf sample is considerably less than for the hearing. The deaf not only performed at a level inferior to the hearing, but seemed not to have sufficient common experience for substantial "learning" to occur.

The deficit in the language of the deaf is a many-faceted problem. However, one aspect of it, is pointed up by Watts in his discussion of the concrete and the abstract in language. He stated, "The difficulty... is that the language required for general discussion comes easily only to those accustomed to comparing freely with one another ideas which they have separately experienced, so that when experience is scanty and discussion rare this kind of language is not readily acquired. As long as children need language merely for telling what they have seen or heard done, without attempting to summarize it briefly or to express any judgment about it, they will have little or no need of words other than those which call up pictorial images of concrete things and events" (Watts, 1944, p. 22).

Moran Word Tests

In this section the separate results for the six Moran tests were reported and discussed. Except for the Similarities and Analogies Tests that were not given to the H(11) group, the tests were given to all hearing age groups at both testing sessions, and to the D(22), D(31), and D(32) age groups. For these tests, means, standard deviations, and _t_ values for selected comparisons are presented in Appendix A.

Word Definitions Test (Moran)

Each definition was classified as correct (+), partically correct (½+), or incorrect (-), and the sum in each classification was taken as the score for thing and nonthing referent and for total words. It was expected that at the older age levels the number of (-) definitions would be smaller and the number of (+) definitions would be larger, and that the number of (½+) definitions would vary with age, tending to become larger at the younger and smaller at the older ages. Results for the Word Definitions Test are presented in Tables A-VI-2 to A-VI-7.

First and Second Testing Session Comparisons

Table 6.5 summarizes the significance of differences for comparisons between Session I and Session II for all hearing age groups and for D(3).

Table 6.5. Moran Word Tests: Word Definitions. Total, Thing, and Nonthing Items by Hearing and Deaf Age Groups, t values between Scores Obtained at First and Second Testing Sessions.

	Hearing			Deaf
	(1)	(2)	(3)	(3)
TOTAL				
(-)	10.17**	1.79	0.78	4.08**
(½+)	3.74**	1.52	2.68**	0.50
(+)	4.86**	2.36*	2.75**	3.17**
THING ITEM				
(-)	1.45	0.57	0.59	3.68**
(½+)	1.20	1.28	2.50*	0.54
(+)	1.84	1.06	2.24*	2.83**
NONTHING ITEM				
(-)	11.12**	2.11*	0.69	2.67*
(½+)	5.39**	1.23	3.46**	0.00
(+)	4.48**	2.18*	2.31*	2.73**

Hearing. The definition of thing referent words was relatively easy for the hearing subjects (Table A-VI-2). The mean (+) score for the H(11):CA 6 group was 7.6, over three-fourths of the possible score. For the H(32):CA 14 group it was 9.2, over nine-tenths of the possible score. The slight increase in (-) scores for the H(2) group over the two-year span was not in the expected direction. The (½+) scores decreased for all age groups. For all three age groups, none of the differences in scores between Session I and Session II was significant at the .01 level (Tables 6.5 and A-VI-2).

The definition of nonthing referent words was more difficult. The youngest hearing subjects at the first testing session defined 2.0 words correctly, less than one-seventh of the maximum; the oldest subjects at the second testing session defined 12.6 words correctly, 84 per cent of the maximum possible. The increments in scores were all in the expected directions. Between H(11) and H(12) the decrease for (-) and the increases for (½+) and (+) scores were significant; between H(21) and H(22) the changes were not significant; between H(31) and H(32) only the decrease in (½+) scores was significant.

The number of correct definitions for the total test varied between two-fifths and four-fifths of the words. All changes between sessions were in the expected directions. In comparisons at H(11)-H(12), changes reached the .01 level of confidence on the increase of both (½+) and (+) definitions, and on the decrease of incorrect definitions. In comparisons for H(31)-H(32), improvement of definition was emphasized in the significant decrease of (½+) and increase of (+) scores.

Deaf. The number of thing referent words correctly defined by the deaf subjects increased from 42 to 67 per cent of the words. Between the sessions there was a significant increase for the D(3) group in (+)

definitions, and a significant decrease in (-) definitions. However, the number of (½+) definitions increased insignificantly, in the pattern expected of younger rather than older subjects (Tables 6.5 and A-VI-4).

The increase in the number of (+) definitions for nonthing words from about 20 to 40 per cent was significant for the D(3) group. However, there was no change in the number of (½+) definitions, and the decrease in (-) definitions was just below the .01 level.

The number of (+) definitions for the total words increased from 7.3 to 12.9, that is from nearly one-third to one-half of the words. The number of (-) definitions decreased significantly and the number of (½+) definitions showed an insignificant increase between Session I and Session II.

Sex Comparisons within Age Groups

Hearing. Essentially no differences were found in the performances of hearing boys and girls at the same age levels for thing and nonthing referent words and for total words (Table A-VI-3). Of 54 comparisons, only 3 reached the .01 level of confidence; two in which girls and one in which boys received the higher score. On 31 comparisons, boys correctly defined more words: 10 thing, 10 nonthing, and 11 total scores.

Deaf. None of the 27 comparisons between boys and girls at the same age level was significant when the deaf age groups were compared (Table A-VI-5). In approximately half of the nine comparisons within each word definition classification, boys received the higher score (5, 4, and 4 comparisons respectively).

Age Comparisons

Hearing. When scores for groups separated by one year in age were compared, the differences between the H(12)-H(21):CA 8-9 were not significant (Table A-VI-7). The mean number of words in all categories cor-

rectly defined by the younger age group was lower, and of words incorrectly defined was higher, than those of the older age group. The younger age group defined more words partially correct than the older age group.

For H(22)-H(31):CA 11-12 comparisons the 11-year-old group incorrectly defined fewer words than the 12-year-old group. Only the comparison on (½+) definitions of the nonthing referent words differed significantly ($t = 3.31$). The mean (½+) definitions of total words was smaller, although insignificantly, for the 11-year-olds.

When the age groups separated by three years (CA 6-9, 8-11, 9-12, 11-14) were considered, the pattern of comparisons of the thing referent words differed from those of the nonthing referent words and the total. For the thing referent words, none of the differences in scores between the younger and older age groups was significant. When the younger testing age was 6 or 8 years, the number of (-) scores decreased, but when the younger testing age was 9 or 11, a slight increase or essentially no change was found. At all ages the number of (½+) definitions of thing referent words decreased insignificantly, while, for the most part, the number of correct (+) definitions increased.

The patterns of comparisons on the nonthing referent and total words, however, were the same. The number of (+) definitions was higher and at a significant level over the three-year span in all the comparisons. The mean number of (½+) definitions was significantly higher in the comparisons in which the younger age group was 6 years of age, insignificantly lower when the younger age group in the comparison was 9 years old, and significantly lower in the two comparisons in which the younger age groups were 9 and 11 years. More (-) definitions were offered by the younger age group at a statistically significant level in

the comparisons in which the younger age group was 6 and 8 years. The differences in mean incorrect definitions were not significant for the comparisons in which the younger age group was 9 and 11 years.

As was pointed out previously, the mean score for thing referent words was considerably nearer the maximum score than was the nonthing or total score.

Deaf. None of the scores for the deaf groups separated by one year, D(22)-D(31):CA 11-12, was significantly different. The 11-year age group correctly defined fewer words in the two word categories and total words than the 12-year-olds.

In comparisons between the groups separated by three years, D(22)-D(32):CA 11-14, showed the younger group significantly above the older age group in (-) scores, and significantly below on (+) scores. The younger group offered more partially correct (½+) definitions of thing referent, nonthing referent and total words.

Only on the thing referent items were any significant differences found between the performances of the day and resident school deaf subjects (Table A-VI-6). In the D(22) age group the resident subjects defined significantly more words partially correctly (½+) and the day school subjects defined significantly more words correctly (+) (t = 3.90 and 3.72 respectively). In 27 comparisons the resident school deaf offered more incorrect definitions in five, fewer partially correct definitions in five, and more correct definitions in eight.

Hearing and Deaf. Comparisons between hearing and deaf subjects of the same age were possible at CA 11, 12, and 14 (Table A-VI-7). At these ages, at a statistically significant level, the hearing subjects defined more thing referent, nonthing referent, and total words correctly (+), and fewer such words incorrectly (-), than did deaf subjects. Re-

sults of comparisons of partially correct definitions (½+) however, varied with the category of word and the age. At CA 14, the hearing gave significantly fewer partially correct definitions for thing referent, nonthing referent and total words. At CA 12, while the hearing also gave fewer partially correct definitions for all categories of words, the differences were not significant. At CA 11, the hearing offered fewer partially correct definitions at a significant level only for thing referent words.

Comparisons between hearing and deaf subjects of the different ages presented different patterns for thing referent, nonthing referent, and total words. For thing referent words, deaf subjects at the ages tested gave fewer correct definitions (+), more incorrect definitions (-), and, with one exception, more partially correct definitions (½+) than the hearing subjects at CA 6. For partially correct definitions, no age comparisons except the one between CA 14 hearing and deaf were significant. For both correct and incorrect definitions, the differences were significant between the deaf at CA 14 and the hearing at CA 9 and older; between the deaf at CA 12 and the hearing at CA 8 and older; and between the deaf at CA 11 and the hearing at CA 6 and older. In terms of raw scores, the mean number of words correctly defined by the D(32): CA 14 group was 6.7, that for the H(11):CA 6 group was 7.6, and for the H(12):CA 8 group, 8.5. The comparable means for words incorrectly defined were 1.2, 0.6, and 0.3.

For nonthing referent words, the hearing and the deaf showed fewer significant differences in the same age comparisons, and the directions of the higher scores were not as consistent over the age comparisons. Considering incorrect definitions, the CA 14 deaf gave significantly more than the CA 8 and older hearing groups, but insignificantly less

than the CA 6 hearing. The CA 12 and the CA 11 deaf also gave significantly more incorrect definitions than the CA 8 hearing, but insignificantly less than the CA 6 hearing. There was considerable decrease in the number of incorrect definitions offered by the hearing subjects from CA 6 to CA 8, but the decline in incorrect definitions offered by the deaf at the three ages tested was more gradual. The CA 6 hearing had a mean of 10.8 and the CA 8 hearing a mean of 3.4 incorrect definitions. The mean number of incorrect definitions for the deaf decreased from 10.4, to 5.8 between CA 11 and CA 14.

Considering correct definitions of nonthing referent words. Both the deaf and the hearing showed a rather steady increase in the mean number as the age level increased, and for both, the increases at the younger ages tested were somewhat larger. It should be remembered, however, that the youngest hearing were CA 6 and the youngest deaf, CA 11. The performance of the CA 14 deaf fell between that of the CA 8 and CA 9 hearing (mean correct nonthing referent word definitions were 6.2, 5.7 and 7.5, respectively, for the CA 14 deaf, and for the CA 8 and CA 9 hearing groups). Significantly fewer correct definitions of nonthing referent words were given by the CA 11 deaf than by the CA 8 and older hearing, by the CA 12 deaf than by the CA 9 and older hearing, and by the CA 14 deaf than by the CA 11 and older hearing. Comparisons between CA 11 and CA 12 deaf and younger hearing age groups were not significant. The CA 14 deaf, however, gave significantly more correct definitions than the CA 6 hearing, but the differences between the CA 14 deaf and the CA 8 and 9 hearing were not significant.

Fewer significant differences were found in comparisons on partially correct definitions. Comparisons between the deaf and the younger hearing subjects tended to find the younger hearing children giving more

partially correct definitions at both significant and nonsignificant levels than the deaf. This finding did not hold for comparisons between H(11):CA 6 and the three deaf age groups, and between H(31):CA 12 and D(32):CA 14 in which the deaf offered more partially correct definitions at a nonsignificant level.

When the total words are considered the pattern of the comparisons more nearly resembles that of the comparisons on nonthing than on thing referent words.

Discussion

The scoring of the definitions used by Moran was not identical to the scoring used in this study (see chapter III and Appendix B). Nevertheless they are sufficiently similar so that comparison of the scores on the definitions formulated by the subjects in both studies can be meaningful. The normal adults studied by Moran adequately defined significantly more total words than the 14-year-old hearing whether the comparison is based on the number of correct definitions only ($\underline{t} = 6.43$) or on the number of totally and partially correct definitions ($\underline{t} = 4.67$) of the 14 year olds. Moran reported a total word mean of 24.5, standard deviation 1.95, for the adequate definitions given by the normal adults in his sample.

The performance of the deaf is inferior to that of the hearing in correctly defining thing referent, nonthing referent, and total words. For all scores, deaf subjects are significantly inferior to hearing subjects of the same age. The deaf resemble the hearing six or more years younger in the number of correct definitions of thing referent words offered, the hearing four to five years younger in the number of nonthing referent words defined, and five to six or more years younger in the mean number of total words correctly defined.

The longitudinal performance of the deaf and hearing differed. (Table 6.5). For the hearing, decrements in mean number of incorrect definitions were significant only for the youngest hearing on the nonthing referent and the total words. Increments in the mean number of correct definitions were not significant for any comparisons on thing referent words. They were significant only for the youngest hearing on nonthing referent words, and for the youngest and oldest hearing on total words. Partially correct definitions increased significantly for the youngest hearing on nonthing referent and total words, and decreased in all other comparisons. The decrease was significant for the oldest hearing on nonthing referent and total words.

The deaf, however, showed significant increases in correct, significant decreases in incorrect, and no significant change in partially correct, definitions between CA 12 and CA 14. This pattern of shift differed from those of any hearing group. Although the significant shifts in (-) and (+) scores are probably most comparable to the shifts between CA 6 and CA 8 for the hearing, the static performance of the deaf in the formulation of partially correct definitions does not occur among the hearing.

While no attempt was made to categorize the definitions written by the subjects, the general impression from reading and scoring the definitions is that the deaf showed a much greater tendency to perseverate the grammatical form used for both incorrect and correct definitions. An example from the paper of one deaf child follows: "A house is what? to live in." "A clock is what time." "A clothes is what to wear." "A car is what to ride in." "A dirt is what to" "A food is what to apple." Thus the question was systematically included in the response, and the definition was introduced by "to" regardless of the appropriateness of

the preposition. Perseveration of form of response was found in responses such as "A (stimulus word) is ---" followed by either grammatically correct or incorrect completions. Other very satisfactory definitions were given by the deaf in incomplete or complete sentences, e.g., garbage - "waste food," and street - "is a place where trucks and cars go."

Synonym Recall (Moran)

The scores derived for thing referent, nonthing referent, and total words were (1) the number of word responses, (2) the number of synonym responses, and (3) the percentage of synonym responses. Mean scores and selected comparisons are presented in Appendix A, Tables A-VI-8 to A-VI-13, for all hearing groups and for the D(22), D(31), and D(32) groups.

Better performance in this test is associated with more synonym responses and a higher percentage of synonyms. A higher number of word responses might also be expected to be associated with better performance, but to a lesser degree, since the number of responses may increase without a corresponding increase in the number of synonyms.

First and Second Testing Session Comparisons

Table 6.6 shows the significance of differences for comparisons between Session I and Session II for all hearing age groups and for D(3).

Table 6.6. Moran Word Tests: Synonym Recall. Hearing and Deaf Age Groups, t Values between Scores Obtained at Sessions I and II.

	Hearing (1)	Hearing (2)	Hearing (3)	Deaf (3)
TOTAL SCORES				
N Responses	7.02**	4.04**	2.64*	2.30*
N Synonyms	11.27**	0.05	2.62*	2.68*
% Synonyms	2.71**	2.05*	6.19**	1.82
THING ITEM SCORES				
N Responses	5.29**	4.10**	3.48**	2.27*
N Synonyms	5.94**	2.89**	4.30**	3.58**
% Synonyms	2.97**	3.49**	7.08**	3.63**
NONTHING ITEMS SCORES				
N Responses	7.58**	2.97**	2.13*	1.94
N Synonyms	3.89**	2.00	0.87	0.84
% Synonyms	3.40**	0.03	3.38**	0.11

Hearing. On the thing referent items, the shifts in performances between the first and second testing session were significant and in the expected direction for H(1), H(2), and H(3). Between the two testing sessions, the number of synonyms offered and the percentage of synonyms increased significantly for each age group. In the number of words given, H(1) increased significantly, and H(2) and H(3) decreased significantly, between sessions (Table A-VI-8).

The number of correct synonyms offered for thing referent words was not high. Between CA 6 and CA 8 the increase was from about .5 to 2.6 words; between CA 9 and CA 11, from three to five words; and between CA 12 and CA 14, from 4.8 to 8.8 words. Thus, even at the last testing, the oldest hearing subjects (CA 14) still offered less than one synonym for every stimulus word.

On the nonthing referent items, the number of synonym responses increased significantly for the youngest H(1) group, but decreased or in-

creased insignificantly for the older groups. The percentage of correct synonyms showed a significant increase for the youngest and the oldest groups; for the middle age group, there was virtually no change. The number of responses increased significantly for H(1), decreased significantly for H(2), and decreased below the level of significance for H(3).

The number of synonyms offered for the nonthing referent words by H(32):CA 14, the oldest hearing subjects, was also less than one for each stimulus word. The mean number of synonyms increased from .5 to 2.3 between CA 6 and CA 8, decreased from 7.4 to 5.4 between CA 9 and CA 11, and increased from 11.0 to 12.2 between CA 12 and CA 14.

On the total words, there were significant increases in number of synonyms and number of responses for H(1) between CA 6 and CA 8. For H(2), the only significant shift between CA 9 and CA 11 was in the decrease in number of words offered. The only significant shift for H(3) between CA 12 and CA 14 was in the increased percentage of synonyms.

Deaf. Only the comparison of D(31)-D(32):CA 12-14 was possible (Table A-VI-10). The group made statistically significant increments in the number and percentage of synonyms for thing referent words only. The number of responses increased from Session I to Session II, but not significantly. The number of synonyms offered increased from 2.3 to 4.8, indicating that at CA 14 less than 0.5 synonyms were offered for each thing referent stimulus word.

For the nonthing referent words, D(3) showed essentially no change in performance between the two testing sessions. The increments in the number of responses and synonyms were not statistically significant, and the percentage of synonyms offered remained about the same. About one-fourth of a synonym was offered for each stimulus word at both the

first and the second testing sessions. It is apparent that the spontaneous recall of synonyms for nonthing referent words was too difficult a task for the D(3) group at both sessions.

For total words, D(3) increased at a nearly significant level on number of synonyms and nonsignificantly on number of responses and on percentage of synonyms between the two testing sessions.

While the group showed changes in the expected directions on the thing referent words, their performances on nonthing referent and total words were essentially unchanged over the two years between CA 12 and CA 14.

Sex Comparisons with Age Groups

Hearing. Only the H(32) boys and girls differed significantly on the number of responses offered (for nonthing and total words), number of correct synonyms (nonthing words). In each of the three instances girls scored higher (Table A-VI-9). Girls offered more synonyms at four ages for thing referents and for nonthing referent words, and at three for total words. Girls offered more responses at two ages for thing referent stimulus words, at four for nonthing referent words, and at four for total words. The latter two comparisons were significant.

Deaf. Deaf boys and girls did not differ significantly on any of the nine comparisons of number of synonyms or number of responses. In six of the nine comparisons, boys' scores were higher than girls' (Table A-VI-11).

Age Comparisons

Hearing. When the hearing groups at H(12)-H(21):CA 8-9 were compared (Table A-VI-13), no significant differences in performance on the thing referent words were found. On the nonthing referent words, however, the CA 9 group gave significantly more synonyms, and the percen-

tage of synonyms was significantly higher. Comparisons between H(22)-H(31):CA 11-12 revealed significantly more responses on the thing referent words, and more responses and correct synonyms on the nonthing referent words by the CA 12 group. The pattern on total words at both age comparisons most resembled that for the nonthing referent words.

When comparisons of number of synonyms were made between hearing groups separatad by three years (CA 6-9, 8-11, 9-12, and 11-14), a higher number of synonyms was given by the older age groups in each comparison for thing referent, nonthing referent and total words. The differences were significant in all comparisons except on thing words between CA 9-12 ($t = 2.34$).

Results of comparisons of the number of responses are similar for the thing referent, the nonthing referent and total words but different from those for the number of synonyms. For the comparison between CA 6-9, the older group gave significantly more responses for all word categories; for the comparison between CA 8-11 the older age group gave significantly fewer responses for all word catetories; for the comparison between CA 9-12 there were no significant differences for any word category; and for the comparison between CA 11-14 the number of responses were significantly higher for the nonthing referent and total words but below the .01 level for thing referent words ($t = 2.65$).

It would seem that there is a tendency for children over the youngest age span tested to give more synonyms and nonsynonyms as they increase the number of responses. Over the next older age spans, they tend to reduce the number of responses while increasing the number of synonyms offered. Finally, at the oldest age span tested the number of synonyms and the number of responses increases at a time when percentage of synonyms to responses is high. Essentially the same pattern holds

for thing referent, nonthing referent and total words.

Deaf. The only significant change shown in the performance of the deaf between CA 11 and CA 12 was in the increase in the number of synonyms offered for nonthing referent words. Between CA 11 and CA 14, however, all comparisons were statistically significant (Table A-VI-13).

The performances of the day and resident school deaf at the same age were essentially the same. Of 27 comparisons made, only two differed significantly: the percentage of synonyms offered by the day school deaf for thing referent and total items (t = 3.16 and 3.22, respectively). The day school deaf showed more satisfactory performance in 3 of the 9 comparisons on number of word responses, in 6 of 9 comparisons on number of synonyms, and in 8 of the 9 comparisons on percentage of correct synonyms (Table A-VI-12).

Hearing and Deaf. When comparisons were made between deaf and hearing at the same ages, comparisons were possible at three ages: CA 11, 12, and 14 (Table A-VI-13). The hearing groups offered significantly more synonyms for thing and nonthing referent and total words at all three ages. The hearing gave a significantly higher percentage of synonyms in all comparisons, except at CA 12, on the thing referent words, when the higher percentage was not significantly different. Comparisons on the number of words offered varied, although in six instances the hearing offered more words at a significant level; in only one (CA 14 on thing referent words), did the deaf offer slightly more words than the hearing.

Comparing the performance of the CA 14 deaf with that of the hearing at younger ages on thing referent words, the deaf most resembled the CA 11 to CA 12 hearing on the number of correct synonyms and fell between the CA 6 to 8 hearing on the number of words offered. On non-

thing referent words the CA 14 deaf performed between that of the CA 8 and 9 hearing on the number of synonyms and between the CA 6 and 8 on the number of responses. Performance on total words most resembled that on the nonthing referent words.

The CA 12 deaf most resembled the CA 8 to 9 hearing on the number of synonyms offered in all categories of words, and the CA 6 to 8 hearing on the number of responses. The CA 11 deaf most resembled the CA 6 and CA 8 hearing in both number of synonyms and number of responses.

In the number of synonyms offered for thing referent words, the deaf are approximately four to five years inferior at CA 11, three to four years inferior at CA 12, and two to five years inferior at CA 14. For nonthing referent words, they are approximately five years inferior at CA 11, three to four years inferior at CA 12, and five years inferior at CA 14. For total words they are between three to five years inferior at all ages.

In the number of word responses, no trends in amount of inferiority appeared with increasing age of the deaf subjects. For the most part, the inferiority of the deaf was between four and six years, regardless of CA or word category.

Discussion

In comparing the performance of the adults studied by Moran with that of the hearing subjects in this study, only total words can be considered since Moran did not present a breakdown by thing and nonthing referent words. The adults gave significantly more synonyms than the CA 14 hearing ($\underline{t}$ = 3.35: adults, 29.1, standard deviation 10.3). The mean percentage of correct synonyms given by Moran adults (59.4, standard deviation 10.4) was below that given by H(32):CA 14 ($\underline{t}$ = 2.56) and significantly above that given by H(31):CA 12 at the .01 level ($\underline{t}$ = 3.62).

The performances of both the deaf and the hearing were relatively low on this test indicating that recalling synonyms is a difficult task. This is emphasized by Moran's finding that the mean number of synonyms offered by adults is only about 1.2 per stimulus word. Hearing subjects in the present study offered about .04 synonyms per stimulus word at the youngest age, and increased to .8 synonyms at CA 14, the oldest age tested. The deaf at CA 11 offered about .1 and at CA 14 about .5 synonyms per stimulus word.

The hearing offered about the same number of synonyms for thing and nonthing referent words. The deaf, however, offered fewer synonyms for the nonthing referent words. At CA 14 they gave about .5 synonyms per thing referent stimulus word and about .3 per nonthing referent word.

In longitudinal performance, the hearing showed significant increments in the number of synonyms given for thing referent stimulus word for all age groups, and a significant increment for nonthing referent words only in the H(11)-H(12):CA 6-8 comparison. The deaf showed a significant increment in the number of synonyms given for thing referent words but not for nonthing referent words between D(31)-D(32):CA 12-14.

Synonym Recognition Test (Moran)

On the Synonym Recognition Test, for thing referent, nonthing referent and total words, the following scores were obtained: (1) Number of Synonyms recognized, (2) number of Nonsynonyms identified as synonyms, (3) number of Neologisms identified as synonyms, (4) Percentage of Synonyms in all identifications, and (5) Percentage of Neologisms in all identifications. Scoring data and selected t values are presented in Tables A-VI-14 to A-VI-19.

Better performance on this test is associated with the recognition of both more and a higher percentage of synonyms, of fewer nonsynonyms, and of both fewer and a lower percentage of neologisms.

First and Second Testing Session Comparisons

Table 6.7 presents the $\underline{t}$ values between mean scores obtained at the first and second testing sessions by the hearing and the deaf.

Table 6.7. Moran Word Tests: Synonym Recognition. $\underline{t}$ Values between Scores Obtained on Sessions I and II by Hearing and Deaf Age Groups.

	Hearing			Deaf
	(1)	(2)	(3)	(3)
TOTAL WORD SCORES				
N Synonyms	1.13	0.90	0.08	1.45
% Synonyms	3.28**	2.10*	1.33	0.28
N Nonsynonyms	2.37*	1.54	1.47	3.72**
N Neologisms	3.27**	1.43	2.27*	1.48
% Neologisms	4.77**	1.40	1.80	0.42
THING ITEM SCORES				
N Synonyms	2.62*	0.36	0.88	0.87
% Synonyms	1.19	1.92	2.51*	0.26
N Nonsynonyms	2.46*	1.54	1.70	3.88**
N Neologisms	2.25*	1.36	1.85	0.88
% Neologisms	3.09**	1.21	1.26	0.22
NONTHING ITEM SCORES				
N Synonyms	3.06**	2.08*	0.69	1.12
% Synonyms	5.38**	1.48	0.21	0.21
N Nonsynonyms	1.73	1.75	0.83	3.26**
N Neologisms	2.98**	1.10	1.14	2.26*
% Neologisms	3.04**	1.15	0.82	1.30

Hearing. In no longitudinal comparisons for the three word categories do the number of Synonyms recognized and the Percentage of Synonyms identified increase significantly over the two-year period (Table A-VI-14). On the thing referent words both scores shifted in the expected direction for all age groups. On the nonthing referent words,

however, the number of Synonyms recognized decreased at all three ages -- significantly so in the CA 6-8 comparisons -- and, while the Percentage of Synonyms score increased slightly for the H(2) and H(3) groups, it decreased significantly for the H(1) group. The total scores showed the same pattern of increases and decreases as the nonthing item scores except that the decrease between sessions for number of Synonyms for H(1) was not significant.

The scores that were expected to decrease on the second testing session -- number of Nonsynonyms, number of Neologisms and Percentage of Neologisms -- did so on thing, nonthing and total words for the H(2) and H(3) groups, but the decrement was not statistically significant. Between CA 6 and 8, however, the number of Nonsynonyms increased for all categories of words although not significantly. The Percentage of Neologisms scores decreased significantly for all word categories and the number of Neologisms for nonthing and total words.

Expected increased in number of Synonyms and in Percentage of Synonyms scores of the same subjects over a two-year period did not consistently occur, and when increments did occur they were not statistically significant. However, for the most part, expected decreases in scores did occur, although the only decrements that were statistically significant occurred for the youngest hearing.

Deaf. The deaf between CA 12 and 14 showed increases in all scores, expected and unexpected, with the exception of the Percentage of Synonyms in thing items and total scores. Only the increase in number of Nonsynonyms for all three word categories were significant however (Tables 6.7 and A-VI-16).

Sex Comparisons within Age Groups

Hearing. None of the mean scores of hearing boy and girl subgroups

at the same age differed significantly (Table A-VI-15). Boys received the higher scores in 18 of 54 comparisons with no pattern of higher scores apparent.

Deaf. Although none of the mean scores obtained by deaf boy subgroups differed significantly from those of deaf girl subgroups at the same ages, in 23 of the 27 comparisons, the boys received higher scores (Table A-VI-17). Only the testing of the D(22) group were the mean scores of the girls consistently higher than those of the boys.

Age Comparisons

Hearing. Between CA 8 and CA 9 only the differences in the number of Synonyms recognized for the thing referent and the total words were statistically significant (Table A-VI-19). The number of Nonsynonyms identified was lower, but at a nonsignificant level for the older group on thing referent and on total words; the number of Neologisms, however, was greater for the older group.

Between CA 11 and CA 12 only one significant difference in mean scores was found: for Synonyms recognized on nonthing words.

When performances of hearing subjects separated by three years were examined (CA 6-9, 8-11, 9-12, and 11-14), it was found that the older group recognized a greater number of Synonyms at a significant level for thing referent and total words in the CA 6-9 comparison, and for all three categories in the CA 8-11 comparisons.

Except for the CA 6-9 comparison, the hearing group three years younger consistently identified a greater number of Nonsynonyms than the older groups. When the younger group in the comparisons was at CA 8, 9, or 11, the difference was statistically significant for thing referent and total words. However, only at the CA 9-12 comparison was the difference for nonthing referent words significant.

Although the younger hearing groups consistently identified a greater number of Neologisms, the decreases were not statistically significant in any of the comparisons between groups separated by three years.

Deaf. None of the comparisons between the performances of the deaf at CA 11 and CA 12 was statistically significant (Table A-VI-19). In only one instance (Synonyms for thing referent words), however, was the mean score of the older group numerically higher than that of the younger group.

In the comparisons between CA 11 and CA 14, too, none of the differences is significant. The number of Synonyms recognized and the number of Nonsynonymous identified for all word categories were higher for the older deaf. However, the older deaf identified fewer Neologisms in the thing referent and total word categories.

The day and resident school deaf showed no significant differences in any score for any category. The day school deaf received higher mean scores in 12 and the resident deaf in 15 of the 27 comparisons made (Table A-VI-18).

Hearing versus Deaf. When hearing and deaf at CA 11, 12, and 14 were compared at all ages the hearing recognized, at a statistically significant level, a greater number of Synonyms on the thing referent, nonthing referent, and total words (Table A-VI-19). At CA 14, the deaf identified a significantly higher number of Nonsynonyms for thing referent, nonthing referent, and total words, but at CA 11 and CA 12 the number identified by the deaf and hearing did not differ significantly. At all ages, the deaf and hearing did not differ in the number of Neologisms identified.

Comparisons on number of Synonyms recognized for thing referent

words by the deaf and the hearing at different ages showed that the CA 14 deaf resemble the CA 8 hearing, and both the CA 11 and the CA 12 year old deaf resemble the CA 6 to CA 8 hearing. On the nonthing referent words, however, the deaf at all ages tested were significantly below the performance of the CA 6 hearing in the number of Synonyms recognized. On total words, the number of Synonyms recognized correctly by the CA 12 and CA 14 deaf was below that of the CA 6 hearing, while that of the CA 11 deaf was similar to that of the CA 8 hearing.

The CA 14 deaf identified significantly more Nonsynonyms than the CA 11, 12, and 14 hearing but did not differ significantly from the CA 9 and younger hearing on thing referent words. On nonthing referent words they resembled the CA 11 hearing, although they identified significantly more Nonsynonyms than the hearing above this age.

The CA 11 and CA 12 deaf tended to identify fewer Nonsynonyms than the hearing children in all categories of words. On nonthing referent words, the CA 12 deaf performed similarly to the hearing of the same age; the CA 11 deaf, with one exception did not differ from any of the younger hearing groups. On thing referent words the CA 12 resembled the 9 year and older hearing, but identified significantly fewer Nonsynonyms than the hearing age groups at the same age and younger.

Discussion

The hearing in the present study performed considerably below the normal adults in the Moran study on the Synonym Recognition test. The highest mean number of Synonyms (38.0) recognized was significantly below the 53.6 synonyms recognized by normal adults (t = 4.48). The adults identified synonyms in 77.2 per cent of their choices. This is significantly above the 64.5 per cent identified by the CA 12 hearing, but not significantly above the 70.5 identified by the CA 14 hearing (t = 3.87

and 1.87, respectively).

The test proved to be difficult for both deaf and hearing, since at no age were more than half of the synonyms presented recognized. The percentage of possible synonyms identified by the CA 14 hearing was 49 per cent for thing referent, 37 per cent for nonthing referent, and 40 per cent for total words. The deaf at this age identified 23 per cent of the thing referent, 16 per cent of the nonthing referent and 18 per cent of the total words.

The deaf in the actual number of Synonyms recognized, resembled younger hearing subjects. On the nonthing referent words, the deaf at ages 11, 12, and 14 recognized fewer synonyms than six year old hearing. On the thing referent words, the number of years of inferiority increased with the older deaf tested.

The hearing and the deaf did not differ in their incorrect choices. Of the possible Nonsynonyms, the maximum selections of the hearing were 57 per cent for the thing referent, 44 per cent for the nonthing referent, and 48 per cent for the total words. The maximum selections for the deaf were 60, 44, and 50 per cent, respectively. Both in the number of Neologisms and in the Percentage of Neologisms the deaf and hearing tended not to differ.

The longitudinal analysis emphasizes the inadequacy of the Synonym Recognition test for this group, since at no age did the hearing or deaf show significant improvement in the number or Percentage of Synonyms recognized over the two year period. None of the comparisons for the hearing showed significant decrements in the selection of Nonsynonyms. Significant decrements in the number of Neologisms or in the Percentage of Neologisms chosen occurred only between CA 6 and 8. The deaf showed no significant decrements in these latter scores, but, contrary to ex-

pectancy, they showed a significant increment in the number of Nonsynonyms selected for nonthing referent and for total words.

No differences were found between hearing boys and girls nor between deaf boys and girls. Within the deaf sample the resident and the day school deaf did not differ in their scores.

Sentence Construction Test (Moran)

In the Sentence Construction Test one, two, or three words were presented for use in the construction of individual sentences. Categories under which the sentences are classified as Adequate or Inadequate are presented in Appendix B. Relevant data on the mean number of adequate sentences constructed by the several hearing and deaf age groups and selected comparisons are presented in Tables A-VI-20 to A-VI-23.

Comparisons between First and Second Testing Sessions

Hearing. The number of adequate sentences constructed increased for each age group between testing sessions (Table A-VI-20). The increment was significant at the .01 level for the youngest age group comparisons, H(11)-H(12):CA 6-8. That the task of constructing adequate sentences was difficult for the youngest hearing group is seen in the low mean number of adequate sentences constructed by CA 6. Rapid progress in adequate construction is apparent in the increase of the mean number from 1.4 at CA 6 to 4.8 at CA 8, an increase of from 12 to 40 per cent in the two-year interval of the possible adequate constructions. For the H(2) group the mean number of adequate sentences constructed increased from 7.5 to 8.0 between CA 9 and 11, a shift of from 62 to 67 per cent. The H(31) group constructed a mean of 9.3 and the H(32) a mean of 10.5 sentences, a shift of from 77 to 89 per cent of the maxi-

mum of 12 sentences.

The CA 14 hearing were, with few exceptions, able to construct sentences that were both meaningful and grammatically accurate.

Deaf. The only longitudinal comparison possible was that for the D(3) group. The D(31):CA 12 deaf constructed a mean of 4.5 and the D(32):CA 14 a mean of 5.19 adequate sentences, an increase in the two-year period in adequate construction of from 38 per cent to 44 per cent of the maximum possible. The increase, however, was not a significant one (t = 1.00).

Sex Comparisons within Age Groups

At the age levels tested no significant differences in the performances of boys and girls were found for either the hearing or the deaf. The hearing boys received the higher score only at the H(11) and H(22) levels; the deaf boys received the higher score at the D(22) and D(31) levels (Table A-VI-21).

Age Comparisons

Hearing. For the hearing separated by one year in age the number of adequate sentences constructed was significant between 8 and 9 but not between 11 and 12 years (t = 3.87 and 1.68, respectively). In all four comparisons over a three year span (CA 6-9, 8-11, 9-12, 11-14), the differences in the number of adequate sentences constructed were all significant (t = 10.86, 4.06, 2.87 and 3.62, respectively; see Table A-VI-23.)

Neither the day school nor the resident deaf subjects constructed a greater number of adequate sentences at any age level tested (Table A-VI-22).

Hearing versus Deaf. When hearing children aged CA 11, 12, and 14 were compared with the same-aged deaf, the latter were significantly in-

ferior in the construction of adequate sentences (t values above 6.88; see Table A-VI-23).

In the construction of adequate sentences, the CA 12 and CA 14 deaf were significantly inferior to 9 year and older hearing subjects (t values 3.03 and above). However, the deaf at these ages were not significantly different from the 8 year old hearing (t values 0.32 and 0.70), and the CA 11 deaf were significantly inferior to the CA 8 hearing (t = 4.14).

All deaf subjects 11 years and older constructed more adequate sentences than the 6 year old hearing. The difference was not significant when the comparison was made between 11 year deaf and six year old hearing, but was significant in the comparisons with the CA 12 and 14 deaf (t = 0.98, 4.81, 6.05, respectively). These findings reflected the rapid increment in construction of adequate sentences between CA 6 and 8 for the hearing, and the difference in the skill between CA 11 and 12 for the deaf.

The mean number of adequate sentences constructed by the 14 year old deaf fell between that constructed by the 8 and 9 year old hearing groups. In less than half of the opportunities presented did the oldest deaf tested construct adequate sentences.

Sentences Constructed According to Number of Stimulus Words

Performances of subjects varied with the number of stimulus words that were to be used in constructing sentences. Two opportunities were given for the construction of sentences using one stimulus word, seven for the construction of sentences using two stimulus words, and three for the construction of sentences using three stimulus words. Table 6.8

Table 6.8. Moran Word Tests: Sentence Construction. Number and Percentage of Adequate and Inadequate Sentences Constructed According to Number of Stimulus Words by Hearing and Deaf Age Groups.

		NUMBER					PERCENTAGE				
			Inadequate[1]					Inadequate[1]			
				Category					Category		
	N	Adequate	(-)	(2)	(3)	(4)	Adequate	(-)	(2)	(3)	(4)
ONE STIMULUS WORD (Two Sentences)											
H(11)	24	18	19	5	5	1	37.5	39.6	10.4	10.4	2.1
H(12)	24	33	2	2	10	1	68.7	4.2	4.2	20.8	2.1
H(21)	24	42	1	4	1	1	87.5	2.1	8.3	2.1	2.1
H(22)	24	44	0	2	2	0	91.7	0.0	4.2	4.2	0.0
H(31)	24	46	1	1	0	0	95.8	2.1	2.1	0.0	0.0
H(32)	24	46	1	0	1	0	95.8	2.1	0.1	2.1	0.0
D(22)	19	19	10	5	1	3	50.0	26.3	13.2	2.6	7.9
D(31)	24	31	5	1	6	5	64.6	10.4	2.1	12.5	10.4
D(32)	23	38	5	0	1	2	82.6	10.9	0.0	2.2	4.3
TWO STIMULUS WORDS (Seven Sentences)											
H(11)	24	18	133	12	5	1	10.7	79.2	7.1	2.9	0.6
H(12)	24	77	26	10	24	31	45.9	15.5	6.0	14.3	18.4
H(21)	24	114	15	8	10	21	67.9	8.9	4.8	6.0	12.5
H(22)	24	112	11	1	26	20	66.7	6.5	0.6	15.5	11.9
H(31)	24	142	5	1	9	12	84.5	2.9	0.6	5.3	7.1
H(32)	24	149	5	8	3	4	88.7	2.9	4.8	1.8	2.4
D(22)	19	17	21	66	18	11	12.7	15.7	49.6	13.5	8.3
D(31)	24	60	4	21	55	28	35.7	2.4	12.5	32.8	16.7
D(32)	23	70	25	8	28	30	43.5	15.5	5.0	17.4	18.6
THREE STIMULUS WORDS (Three Sentences)											
H(11)	24	0	72	0	0	0	0.0	100.0	0.0	0.0	0.0
H(12)	24	9	25	10	16	12	12.5	34.7	13.9	22.2	16.7
H(21)	24	24	20	15	6	7	33.3	27.8	20.8	8.3	9.7
H(22)	24	39	9	3	7	14	54.4	12.5	4.2	9.7	19.4
H(31)	24	35	10	2	12	13	45.8	13.9	2.8	16.7	18.1
H(32)	24	57	4	2	4	5	79.4	5.6	2.8	5.6	6.9
D(22)	19	0	25	23	8	1	0.0	43.9	40.4	14.0	1.8
D(31)	24	20	6	14	20	12	27.8	8.3	19.4	27.8	16.7
D(32)	23	13	32	6	11	7	18.8	46.4	8.7	15.9	10.1

1 Inadequate sentences are categorized as follows: (-) No attempt at sentence construction; (2) Stimulus word(s) not used; (3) Sentence not acceptable grammatically; (4) Sentence absurd or illogical.

presents the number and percentage of adequate sentences, omissions, and types of inadequate sentences.

It is apparent that the hearing subjects at each age group constructed a higher percentage of adequate sentences when one word was given, a smaller percentage when two words were given, and the smallest percentage when three words were given. The decline, according to the number of given words, was smallest for H(32):CA 14.

Subjects in the older hearing age groups consistently constructed more adequate sentences than the younger, regardless of the number of stimulus words. About one-tenth of the sentences constructed using two stimulus words were adequately constructed by the H(11):CA 6, and about one-tenth of those using three stimulus words were adequately constructed by the next older age level, H(12):CA 8. The lowest age level at which more than 50 per cent of the sentences were first adequately constructed with one stimulus word was H(12):CA 8; with two stimulus words, it was H(22):CA 9; and with three stimulus words, it was H(22):CA 11. The lowest age at which 80 per cent of the sentences were first adequately constructed increased from CA 11 to CA 12 to CA 14 for sentences using one, two, and three stimulus words, respectively.

The deaf showed the same patterns (except at D(32):CA 14 in the percentage of adequate sentences constructed using three stimulus words), but their performances were consistently inferior to those of the hearing. The performance of the CA 14 deaf fell between those of the hearing at CA 6 and 8 in construction of sentences using one stimulus word; about at CA 8 in the construction of sentences using two stimulus words, and between CA 8 and 9 in the construction of sentences using three stimulus words.

Inadequate sentences were classified into several categories (see

Appendix B). Category (-) was made up of items in which no attempt was made to construct a sentence. The subject may have done or said nothing, or responded, "I can't," "I don't know how to do it," "I don't know what a sentence is," etc. The hearing at the youngest age was the group that most frequently did not attempt to construct sentences. Regardless of the number of stimulus words to be used, a steady decrease in this type of response occurred with age, although at the oldest hearing age level tested, no attempt to construct sentences still occurred in some instances.

The CA 12 deaf responded by not attempting sentence construction less frequently than the CA 11 deaf, regardless of the number of words given. At CA 14, however, a greater number of such responses occurred when two and three stimulus words were presented, and remained about the same for the presentations of one stimulus word.

Category (2) error was that in which the stimulus word(s) were not used. This error tended to occur somewhat more frequently at the younger ages and in the construction of sentences using fewer stimulus words. It occurred much more frequently for the deaf than for the hearing. Most of the errors for the deaf in this category were those in which the stimulus word was not used and nothing was substituted for it (e.g., "danger falling down.")

Category (3) errors were grammatically unacceptable sentences. Many different kinds of such errors occurred. Among the most common were those in which two or more unrelated statements were used in one sentence (e.g., "street, God -- Cars ride in the street, and God made heaven and earth), and those in which two or more separate sentences were constructed (e.g., "dirt, strong -- The children sometimes played with dirt. My father is strong than I."). There seemed to be a tendency for

the hearing to give more of the former kind and the deaf more of the latter.

Category (4) included sentences that were grammatically accurate but did not accord with fact nor, in general, make good sense (e.g., "<u>clock</u>, <u>garbage</u> -- The garbage was on top of the clock"). Such absurd or ambiguous sentences were constructed by both deaf and hearing. For the deaf, such sentences occurred regardless of the number of stimulus words, bur for the hearing they occurred only a few times in sentences constructed with only one stimulus word.

Discussion

The average number of adequate sentences constructed by the normal adults studied by Moran was 9.7. This mean does not significantly differ either from the 10.5 sentences constructed by the H(32):CA 14 or the 8.04 sentences constructed by the H(22):CA 11 group, but is significantly higher than the 7.50 sentences constructed by the H(21):CA 9 group ($\underline{t}$ = 1.36, 1.60, 2.93, respectively). The oldest deaf subjects D(32):CA 14 constructed significantly fewer adequate sentences than the adults ($\underline{t}$ = 4.46).

The sentence construction of the deaf is inferior to that of the hearing. The inferiority ranging between three and five years is related to the specific comparison. For the most part, the inferiority is less pronounced with a simple than a complex task, i.e., when one rather than several stimulus words were to be used in the construction of a sentence. Despite inferiority of the deaf, however, they did construct a substantial number of adequate sentences using one, two, and three stimulus words. No significant differences are found between resident and day school deaf.

The greater number of inadequate sentences of the deaf cannot be

accounted for by fewer attempts at sentence construction, except when three stimulus words were presented. Rather they are accounted for by a greater number of inadequate responses, particularly those in which a stimulus word was not used, in which two sentences instead of one were constructed, and in which ambiguous sentences were constructed.

In longitudinal comparisons, the hearing showed significant increment between 6 and 8 years. At the older ages the increment was not significant although between 12 and 14 years it does reach the .05 level of confidence. The deaf, however, showed no significant increment between 12 and 14 years.

Boys and girls among hearing or deaf age groups did not differ in performance.

Similarities Test (Moran)

The Similarities Test consisted of 17 items, 7 using thing referent clusters of words, and 10 using nonthing referent clusters. Responses were classified as Abstract, Adequate, and Incorrect (-). Relevant results are presented in Tables A-VI-24 to A-VI-29.

With increasing age, it would be expected that for both thing and nonthing referent clusters the number of incorrect responses would decrease, the number of Abstract responses would increase, and the number of Adequate responses would first increase and then decrease, since lack of any grouping of a cluster of words is the most immature performance, grouping at the descriptive level a more mature, and grouping at a categorical level the most mature response.

First and Second Testing Session Comparisons

Hearing. Longitudinal comparisons were made over a two-year span only on the thing referent cluster items for H(1), and on thing refer-

ent, nonthing referent, and total items for the H(2) and H(3) groups. The H(1) group gave no Abstract responses. The nonthing referent clusters were too difficult for H(11): Only two subjects of the 24 were able to give an Adequate response to one of the ten items.

In all possible comparisons for H(1), H(2), and H(3), the scores of the same subjects changed over the two-year period in the expected direction for the thing referent, nonthing referent, and total items. Incorrect responses decreased, Abstract responses increased, and Adequate responses increased between CA 6-8 and decreased between test sessions at the older ages (Tables 6.9 and A-VI-24).

Table 6.9. Moran Word Tests: Similarities. t Values between Testing Sessions, Hearing and Deaf Age Groups.

	Hearing Groups			Deaf Group
	(1)	(2)	(3)	(3)
TOTAL ITEMS				
(-)	--	1.94	1.55	1.68
Abstract	--	5.81**	5.44**	0.00
Adequate	--	2.46*	5.53**	0.68
THING ITEMS				
(-)	6.93**	1.23	0.83	1.79
Abstract	--	2.74**	4.62**	0.32
Adequate	5.90**	2.40*	4.59**	3.46**
NONTHING ITEMS				
(-)	--	2.06*	1.72	2.69**
Abstract	--	4.32**	4.76**	0.66
Adequate	--	1.54	3.67	3.42**

On the thing referent items the decrease in the number of Incorrect responses was significant only between H(11)-H(12):CA 6-8. Changes in the number of responses categorized as Adequate followed the predicted pattern: The youngest age group, H(1), showed a significant increase, the middle age group, H(2), an insignificant decrease, and the oldest

age group, H(3), a significant decrease. For both the middle and oldest age groups the number of Abstract responses increased significantly over the two-year span.

On the nonthing referent items only comparisons for H(2) and H(3) were possible. The number of Incorrect responses decreased between the first and second testing sessions for both comparisons but not at statistically significant levels. The number of Abstract responses increased significantly for both age group comparisons. The number of Adequate responses decreased over the two-year span for both groups, and was significant for the H(3) group.

For the total responses, Incorrect scores decreased, but not significantly. The increases in Abstract scores were significant in both comparisons, and the decrease in Adequate scores was significant for H(3).

Percentage of Incorrect Abstract and Adequate responses are presented in Table 6.10. Increments in the percentage of Abstract responses

Table 6.10. Percentage of Incorrect, Abstract, and Adequate Responses for Thing, Nonthing, and Total Items by Hearing and Deaf Age Groups.

		Thing Items			Nonthing Items			Total Items		
	N	(-)	Abstract	Adequate	(-)	Abstract	Adequate	(-)	Abstract	Adequate
H(11)	24	81.5	--	17.8	--	--	--	--	--	--
H(12)	24	36.8	9.5	53.5	80.8	11.7	7.5	64.2	10.0	25.7
H(21)	24	33.2	4.1	63.7	76.3	7.5	16.3	58.5	5.6	35.7
H(22)	24	25.0	26.8	48.2	65.4	24.6	10.0	48.7	25.4	25.7
H(31)	24	17.8	20.2	61.8	56.3	17.5	26.3	40.4	18.6	40.9
H(32)	24	13.7	50.0	36.2	46.3	41.3	12.1	32.8	44.8	22.0
D(22)	19	65.8	10.5	22.5	90.0	3.7	6.3	80.4	6.5	13.0
D(31)	24	56.0	12.5	27.4	63.8	9.6	22.5	59.2	11.5	25.0
D(32)	24	44.0	11.2	44.7	81.3	11.7	7.1	65.9	11.5	22.5

between the first and second testing sessions become consistently larger as the groups considered become older. For the thing referent items,

the increases between sessions were 9, 23, and 30 percentage points, respectively, on the H(1), H(2), and H(3) comparisons. For the nonthing items the increases were 12, 17, and 23 percentage points, respectively. The percentage increment in Adequate responses increased on H(1) and decreased on the H(2) and H(3) comparisons. Adequate responses for the thing referent items shifted +35, -16, and -26 percentage points for the respective age group comparisons. Adequate responses for the nonthing referent items shifted -6 and -14 percentage points for the H(2) and H(3).

Deaf. On the only longitudinal comparison possible, the D(31)-D(32): CA 12-14 did not follow the expected pattern of shift in scores (Tables A-VI-26 and 6.10). The number of Incorrect responses decreased 12 percentage points on the thing referent items, but increased 17 percentage points on the nonthing referent items. On both thing and nonthing referent items there was essentially no change in the number of responses classified as Abstract at the two testing sessions. On the thing referent items the number of responses classified as Adequate increased from 27 to 45 per cent, while on the nonthing referent items it decreased from 23 to 7 per cent. Both shifts were statistically significant. When the total number of items were considered, no significant shifts in the performance of the D(3) occurred between the first and second sessions of testing.

Although at the initial testing the levels of performance on the thing referent and nonthing referent items were similar, at the testing two years later, the performance of the CA 14 deaf was considerably better on the thing referent than on the nonthing referent items (44 versus 81 per cent Incorrect responses).

Sex Comparisons within Age Groups

Hearing. In comparisons of the performances of hearing boys and girls (Table A-VI-25), consistent significant differences were found only for H(11):CA 6 on thing referent items: boys made fewer Incorrect and more Adequate responses than girls at a significant level. Essentially, there were no differences between the sexes at other ages, although there was a slight tendency for girls to perform at a somewhat higher level. In the 45 sex comparisons made at CA 8 and above, only one was significant: the H(12):CA 8 girls received higher Adequate scores on nonthing items; boys received higher Incorrect scores on all but one comparison, lower Adequate scores on all but two, and higher Abstract scores on about half the comparisons. The higher Abstract scores for the boys occurred at the younger ages.

Deaf. There were no essential differences in the performance of deaf boys and girls (Table A-VI-27). In 27 comparisons, boys received higher Incorrect scores in 4, lower Abstract scores in 5, and lower Adequate scores in 7. Only one comparison indicated a significant difference.

Age Comparisons

The percentages of Incorrect, Adequate, and Abstract responses obtained at each testing session by the hearing and the deaf age groups are presented in Table 6.10.

Hearing. Examination of Tables A-VI-24 and 6.10 shows that in both comparisons between hearing age groups separated by one year (CA 8-9 and CA 11-12) the younger age group gave more Incorrect and Adequate and fewer Abstract responses for thing referent, nonthing referent, and total items. For both age comparisons the differences were significant only for the CA 11-12 comparison on Adequate scores for nonthing referent and total items (see Table A-VI-29).

When comparisons were made between hearing groups separated by three years, the differences in scores were all in the expected directions. Incorrect responses decreased significantly on thing referent items between CA 6 and 9, and on the nonthing referent and total items at the three older age comparisons, CA 8-11, 9-12, and 11-14. Abstract responses were significantly higher for the older groups for the CA 8-11, 9-12, and 11-14 comparisons on thing referent, nonthing referent, and total items. No comparison was possible between CA 6 and 9 on Abstract scores. Adequate responses were significantly different only on the thing referent items in the CA 6-9 comparison, when the younger age group gave more such responses (Table A-VI-24).

From age to age, the hearing subjects decreased consistently in the number of Incorrect responses to both thing referent and nonthing referent items. The decline was much greater for the thing referent items, however. At each age the percentage of Incorrect responses was considerably higher on the nonthing than on the thing referent items. Between CA 6 and 14 the percentage of Incorrect responses decreased from 82 to 14 on Thing referent items, and between CA 8 and 14 from 81 to 46 on Nonthing referent items (Table 6.10).

Both on thing and nonthing referent items, the percentages of Abstract responses increased irregularly. The percentages of Adequate responses, after an initial increase, between CA 6 and 8 also decreased irregularly. At CA 14 the percentage of Abstract responses reached 50 for thing referent and 41 for nonthing referent items.

Thing referent items for hearing at any age seemed to be somewhat easier than nonthing referent items.

Deaf. When performance of deaf age groups separated by one year, and age groups separated by three years were considered, in both compari-

sons the older age group gave fewer Incorrect and more Adequate and Abstract responses. Comparing the performance of D(21)-D(22):CA 11-12, no significant differences were found in the number of Incorrect, Adequate, or Abstract responses on thing referent items. However, on the nonthing referent items the differences in the number of Incorrect and Adequate responses were significant.

When the comparison was made between scores obtained by the groups separated by three years (D(22)-D(32):CA 11-14), the older age group differed significantly in the mean number of Adequate and Incorrect responses on thing referent items but no differences were found on the nonthing referent items (Table A-VI-29).

The day school and resident deaf were quite similar in their performances (Table A-VI-28). Of the 27 comparisons made between them, only two were significant. The D(31) day school subjects received a significantly higher mean Abstract score on thing referent and total items (t = 3.38 and 3.46, respectively). Day school subjects received higher Incorrect scores in 6 of the comparisons, higher Abstract scores in 2, and higher Adequate scores in 5.

Hearing versus Deaf. When deaf and hearing subjects of the same age were compared, some differences were found in the patterns at CA 11, 12, and 14. At CA 11 the hearing had significantly fewer Incorrect responses, and significantly more Abstract and Adequate responses in all comparisons except one. On Adequate responses on nonthing referent items there were no significant differences.

At CA 12, fewer significant differences occurred. The number of Incorrect responses on thing referent items, Adequate responses on nonthing referent items, and Abstract responses on all categories of items were not significantly different for the deaf and hearing.

At CA 14 the differences in number of Incorrect and Abstract responses were significant in all item categories. No significant differences were found in comparisons of number of Adequate responses at this age.

Comparisons between the deaf age groups and younger hearing groups showed the deaf to be inferior. On thing referent items, the CA 14 deaf gave significantly more Incorrect responses than the CA 8 hearing, and significantly fewer than the CA 6 hearing. The CA 14 deaf gave fewer Abstract responses than CA 11, 12, and 14 hearing age groups. Although the difference at CA 11 was significant, the deaf gave more Abstract responses than the CA 9 hearing at a nonsignificant level.

The irregularity in the number of Adequate responses at the various age levels makes specific comparisons difficult to interpret. However, the distribution of the types of responses for thing referent items of the CA 14 deaf resembled that of the hearing at CA 8 to CA 9.

On the nonthing referent items the scores of the deaf did not change in the expected direction, so the attempt to compare performances across ages was probably not too meaningful. The distribution of responses on categories on nonthing items of the CA 14 deaf was identical with that of the hearing subjects at CA 8. This group was the youngest hearing group whose responses on nonthing items could be scored. The CA 12 deaf, however, resembled the hearing at CA 9 and 11.

Discussion

The normal adults studied by Moran received higher mean Abstract scores than the hearing in all age groups in this study. The differences were not significant between the Moran adults and H(32):CA 14. However, they were significantly above the D(31):CA 12 and D(22):CA 11 groups for thing referent, nonthing referent, and total items (t = 4.25,

3.06, and 4.26 at CA 11 and higher values at CA 12).

For both hearing and deaf, thing referent items were less difficult than nonthing referent items, and the latter were considerably more difficult for the deaf than for the hearing.

In the longitudinal analysis the hearing, in general, shifted in the expected directions. The deaf, however, did not. The level of performance of the CA 12 deaf was not maintained when the same subjects were tested after two years. The mean number of Incorrect responses increased substantially; the number of Abstract responses remained the same and the percentage of Abstract responses decreased from 23 to 7. This decrease would be the expected normal change if there were a corresponding increase in Abstract responses. However, this increase did not occur and the decrease is accounted for by the occurrence of more Incorrect responses. It may be that the performance of the deaf at CA 14 is related to the particular sample of children in this study. It may well be, however, that it is related to a tendency on the part of the older deaf to be more reticent about given possibly incorrect verbal responses.

Analogies Test (Moran)

The Analogies Test was too difficult for the H(11) group, but was administered to the remaining hearing groups and to the D(22), D(31), and D(32) groups. Since the items were not separated into thing and nonthing referents, only a total score was available. The maximum possible score was 11. Performance data on the Analogies Test are presented in Tables A-VI-30 to A-VI-33.

Comparison between First and Second Testing Sessions

Hearing. Only two longitudinal comparisons were possible. The

scores for both the H(2) and the H(3) groups increased between the first and second testing sessions (Table A-VI-30). However, the increase was statistically significant only for the comparison from H(31) to H(32) ($\underline{t}$ = 2.91). For the H(2) group, the mean score increased from 44 to 52 per cent of the possible score from the first to second testing session, and, for the H(3) group, from 66 to 77 per cent.

Examination of the responses of individual subjects showed that for the H(2) group, 99 of the total responses were identical at the two testing sessions, for the H(3) group, 141 of the total responses were identical. For the H(2) group, 69 per cent of all identical responses were correct responses and for the H(3) group 89 per cent of the identical responses were correct. For the H(2) group the mean number of responses correct at both testing sessions was 3.1, for the H(3) group it was 5.4. Of course, some correct responses, particularly at the earlier testing or at the younger age could have been chance. For the H(2) group, 65 per cent of the responses correct at the first testing session were also correct at the second session. For the H(3) group this percentage was 80.

Deaf. The only comparison possible was that for the D(3) group (Table A-VI-30). The scores at the two testing sessions were approximately the same, shifting from 25 per cent of the possible scores at the first testing session to 23 per cent at the second session ($\underline{t}$ = 0.45).

The mean number of correct responses of individual subjects was 0.82. Only 67 responses of the group were identical on both testing sessions. Of these, 19 or 27 per cent were correct in both sessions. Of the 46 items to which correct responses were given at the first testing session, 72 per cent of the responses were incorrect at the second testing session.

Sex Comparisons within Age Groups

The performances of both hearing and deaf boys and girls were not significantly different at any of the age levels testing (highest *t* value = 1.70, see Table A-VI-31). The higher score was received by the boys in one of five comparisons for the hearing and in two of three for the deaf.

Age Comparisons

Hearing. In the two comparisons possible between hearing age groups separated by one year, H(12)-H(22):CA 8-9 and H(22)-H(31):CA 11-12, the differences in scores on Analogies was not significantly different (*t* values below 1.90, see Table A-VI-33). In the three comparisons possible between age groups separated by three years, CA 8-11, 9-12, and 11-14, however, the differences were significant (*t* values above 3.26, see Table A-VI-30). The scores were 33, 44, 52, 66, and 77 per cent of the possible score at ages 8, 9, 11, 12, and 14 respectively.

Deaf. The differences in scores between age groups separated by one year (D(22)-D(31):CA 11-12) and by three years (D(22)-D(32):CA 11-14) were not statistically significant. The deaf obtained 18, 25, and 23 per cent of the possible scores at age 11, 12, and 14 (Table A-VI-33).

The mean scores of the day school deaf subjects at each age level were consistently higher than those of the resident deaf, but the difference was significant only at D(22):CA 8, the youngest deaf age group tested (Table A-VI-32). The day school subjects at 11 years scored higher than those who were 12 or 14 years old. The mean scores of the two older day-school age groups were the same.

Hearing versus Deaf. At CA 12 and 14, the deaf scored significantly below the 9 year old hearing group. The CA 11 deaf scored significantly below the 8 year old hearing, the youngest hearing age group tested.

Thus, the deaf performed at a level at least five years inferior to the hearing on the Analogies test.

When actual scores are considered, the extreme inadequacy of the deaf is emphasized. The highest mean score obtained by the deaf was below that obtained by the eight year old hearing.

Among the hearing at the five age levels tested, multiple responses to any of the items were infrequent - occurring on only three items for H(12) and H(22), and not at all for the H(21), H(31), and H(32) groups. For the deaf, on the other hand, three multiple responses were given at the D(22) level, none at the D(31) level, and 26 at the D(32) level.

Specific test items. Although there is considerable variation in the performance of the hearing on the Analogy items, at 14 years on all but three items (#5, #10, and #11) at least two-thirds of the hearing subjects responded correctly. For the oldest deaf, however, on only one item (#7) did as many as one-fourth of the subjects respond correctly. Table 6.11 lists the most frequent responses on the test for each age group.

For the hearing at increasingly older age levels, the most common response was also more frequently the correct response for the completion of the analogy. At CA 14, the oldest age tested, the correct completion was the most common response in ten of the items, and one of the two common responses in the eleventh test item (#5). For the deaf, there was no trend toward the correct response becoming the most frequent with increasing age. Furthermore, at CA 14 the most common response of the deaf was the correct response on only three items. In all instances, however, the most common response of the deaf was a word commonly associated with the first or third word presented in the analogy item. The most common response of the deaf was also the correct response on three

Table 6.11. Moran Analogies Test. Most Frequent Responses of Hearing and Deaf Age Groups to Each Item[1].

Item	H(12) CA 8	H(21) CA 9	H(22) CA 11	H(31) CA 12	H(32) CA 14	D(22) CA 11	D(31) CA 12	D(32) CA 14
1. Add is to subtract as All is to	<u>nothing</u>	every	<u>nothing</u>	<u>nothing</u>	<u>nothing</u>	plus	plus	plus
2. Boat is to water as Car is to	<u>land</u>, wheels	ride	<u>land</u>	<u>land</u>	<u>land</u>	<u>land</u> ride	<u>land</u>	ride
3. Clock is to watch as Garbage is to	<u>trash</u>	<u>trash</u>	<u>trash</u>	<u>trash</u>	<u>trash</u>	<u>trash</u>	time	<u>trash</u>
4. House is to roof as Street is to	road	road	road	<u>curb</u>	<u>curb</u>	road	car	road
5. Dirt is to plant as Food is to	eat	eat	eat	eat	eat <u>human</u>	seed	eat	eat
6. God is to faith as Enemy is to	<u>hate</u>	<u>hate</u>	<u>hate</u>	<u>hate</u>	<u>hate</u>	Bible	Bible	Bible
7. Door is to building as Button is to	<u>clothes</u>	<u>clothes</u>	<u>clothes</u>	<u>clothes</u>	<u>clothes</u>	roof	<u>clothes</u> handle	<u>clothes</u>
8. Strong is to body as Wise is to	<u>mind</u>	clever	clever	<u>mind</u>	<u>mind</u>	<u>mind</u>	<u>mind</u>	clever
9. Master is to command as Friend is to	order	<u>help</u>	<u>help</u>	<u>help</u>	<u>help</u>	<u>help</u>	<u>help</u>	<u>help</u>
10. New is to age as Big is to	elephant	<u>size</u>	<u>size</u>	<u>size</u>	<u>size</u>	elephant	<u>size</u> strong	strong
11. Danger is to fear as Death is to	sickness	burial	burial	<u>grief</u>	<u>grief</u>	priest	sickness	burial

1 Correct response underlined.

items (#3, #7, #9). On these, a common association to the third word in the analogy item was also the correct completion of the analogy presented.

Inspection of the words included in the specific items and of the most common responses leads to the conclusion that some items are less satisfactory than others. An analogy should not be able to be completed correctly without identifying the relationship involved. However, in several items the correct completion of the analogy was a common association with one of the three stimulus words. On Items #3, #6, and #7, the hearing gave correct responses at all ages, and, in all instances, the correct response is a common association with the third stimulus word in the analogy problem. Two of these items (#3 and #7) are among the three on which the CA 14 deaf gave correct responses.

Other items, however, show a shift in performance that seems to indicate that the relationship presented in the analogy is understood. In Items #2, #4, #5, #8, #10, and #11 the younger hearing responded with a common association to the third stimulus word, and then at an older age responded according to the relationship.

Palermo and Jenkins (1964) recently published word association norms on 200 words based on a normative sample of 500 subjects at each grade between 4 and 12. Only nine of the stimulus and choice words in the analogy items were included in their list, and in only one instance were two of the three stimulus words included: #4. House is to roof as street is to curb, road, car, stair. On this item, three of the four words presented as choices for the completion of the analogy were associated with street: curb with 0 to 4 associations per grade, car with 22 to 34 associations (car and cars combined had 53 to 85 associations), and road with 51 to 128 associations. Only car was associated with

house with 0 to 17 associations (cars is not given as a response to house). The hearing at CA 8, 9, and 11 responded with road then shifted to curb, the correct word to complete the analogy, at CA 12 and 14 but with low association power. The deaf, however, responded at all ages with car and road, the two words with the highest associations.

On Item 9, the CA 6 hearing responded with order, which is associated 121-186 times per grade with command, one of the three stimulus words. The hearing at CA 8 and above, and the deaf at all ages gave help as the most common response. This response would seem to be a reasonable association to friend, the third of the stimulus words, although, unfortunately, neither of these words appears in the Palermo and Jenkins list and the strength of the association cannot, therefore, be checked.

In all except Items #1 and #6 the responses of the deaf were also the responses of the younger hearing. In these two items the responses were probably associated with different words by the deaf and hearing. Thus, in Item 1 the response of the hearing was probably associated with all, and that of the deaf with add. In Item 6, the response of the hearing was probably associated with enemy, and that of the deaf with God. The deaf at all ages responded with Bible on this item. Bible is included in the Palermo and Jenkins list, although God is not. However, they reported that the word God as a response to Bible varied at a frequency between 87 and 198 responses per grade.

Discussion

The mean correct score on the Analogies test obtained by the adults studied by Moran fell between the scores obtained by H(31):CA 12 and H(32): CA 14, and did not differ significantly from either (t = 1.06 and 0.63, respectively).

The performance of the deaf was inferior to that of the hearing by a minimum of probably five years. The longitudinal performance of the hearing and the deaf subjects emphasized the inferiority of the deaf, because, on the whole, they did not show improvement with age.

Examination of the performances of the deaf raises doubts as to whether the oldest deaf subjects really understood the principle of analogy. Their responses were bound by associations to single words in the analogy problem, rather than to a consideration of the relations expressed. A similar tendency toward associative response is seen in the performance of the youngest hearing subjects tested. However, on those items in which a common association to a single word was not the correct completion of the analogy, the performance of the older hearing subjects shifted in such a way as to indicate that they understood the relational principle of analogy.

Discussion of Moran Tests

The Moran tests were about as satisfactory for use with children as they had been with adult subjects. Comparison of the total test scores of normal adults as reported by Moran (1953) were made with those of the hearing subjects in this study. On the whole, the adults performed at a higher level than the 14-year-old children on the tests dealing with word knowledge, but not on the tests dealing with word usage. Compared to the H(32):CA 14 age group, the adults defined more words correctly and partially correctly, recalled more synonyms and recognized more synonyms at a statistically significant level. However, the adults recognized a higher and recalled a lower percentage of synonyms than the 14-year-old hearing. On tests of word usage, the adults, at a nonsignificant level,

constructed fewer adequate sentences, received higher Abstract scores on the Similarities Test, and obtained lower mean scores on the Analogies Test than the 14-year-old hearing.

The mean scores of deaf subjects at CA 11, 12, and 14 were all below those of hearing subjects at the same age levels. On all of the Moran tests except one the scores of the deaf were significantly lower at each age for thing referent, nonthing referent and total words. Only differences in the mean number of Abstract responses on the Similarities Test at CA 12 did not reach the criterion for significance set up for this report, but they did differ at the .05 level of confidence. Thus, the deaf were significantly inferior for the total test on the number of Adequate sentences constructed, the Analogies scores, the number of correct definitions given, the number of synonyms recalled and the number of synonyms recognized, and on the last three scores for the thing and nonthing referent words as well.

Examination of the scores indicating mastery at CA 11, 12, and 14 showed that the number of years of inferiority of the D(32):CA 14 varied from two or three years to more than eight years among the several tests. The greatest inferiority was on the Analogies Test and in number of synonyms identified in the Synonym Recognition Test both for thing and nonthing referent words. The least inferiority was in the number of synonyms for thing referent words on the Synonym Recall Test.

Longitudinal comparisons showed that between CA 12 and CA 14 the deaf did not improve significantly on total scores for any of the tests of word usage. However, the oldest hearing showed significant increments on number of Abstract responses on the Similarities Test and on the Analogies Test; the middle age hearing on the number of Abstract responses on the Similarities Test; and the youngest hearing in the construction of adequate sentences.

Longitudinal comparisons on the tests of word knowledge, however, showed that the deaf tended somewhat to resemble the hearing. The hearing did not show significant increments in the number of synonyms recognized; neither did the deaf. The hearing at all age groups increased at the .01 level in the number of correct definitions given and in the number of synonyms recalled by the youngest and oldest age groups and at the .05 level of confidence by the middle age group. On these two tests, the increments in the scores of the deaf between CA 12 and 14 did not meet the criterion for significance set up for this report; but did reach the .05 level of confidence.

There were some indications that behavior of the oldest deaf subjects over a two year span was rather similar to that of hearing children considerably younger. This was more apparent in less adequate performance. Thus, in the Analogies Test the youngest hearing could not be tested and the middle age hearing showed no significant improvement. In the tests of word knowledge, for the youngest hearing and the oldest deaf the number of incorrect definitions decreased significantly while the number of non-synonyms recognized and the number of responses given on the synonym recall test increased at the .05 or .01 level. It should be noted that the latter two responses decreased for the middle and oldest hearing.

The hearing and deaf subjects did not differ substantially in intellectual ability. It may be that immature performances of the deaf are partially related to their lack of sensitivity to language. This is suggested by the findings that between CA 12 and CA 14 the deaf subjects identified more nonsynonyms and neologisms, but a lower percentage of synonyms, and did not show significant increments in the total scores on all three tests of word usage. Also supportive of the idea of lack of sensitivity to language is the finding of MacGinitie (1965). He reported

that while hearing subjects identified synonyms presented in a helpful multiple-choice context about 15% more frequently than they identified the same words presented in a misleading context, the identification of word by deaf subjects was unrelated to the context in which they were presented.

No major differences between the performances of the residential and day school deaf subjects were found for a particular test or for all three ages compared -- CA 11, 12, and 14. Only on the Analogies Test did the day school subjects consistently obtain higher scores, and the difference is significant only for the D(22):CA 11 group. Of the 114 comparisons, 8 reached the .01 level of confidence: half of the better scores were obtained by resident school subjects and half by day school subjects; half of the better scores occurred on thing referent words, and half on the total test: and in no instance were comparable differences found at two age levels. No significant differences were found on nonthing referent words or between the D(32):CA 14 subgroups.

Within both hearing and deaf samples neither boys nor girls at the same age level consistently obtained better scores. In over 200 comparisons of hearing subsamples, boys and girls received about the same proportion of higher scores associated with better and with poorer performance. Nine comparisons were signficant. Girls more frequently obtained the better scores when significant differences occurred, but only twice was any tentative pattern apparent: on the Synonym Recall Test H(32):CA 14 girls give significantly more responses on total and nonthing referent words, and more correct synonyms on nonthing referent words; and on the Similarities Test H(11):CA 11 girls gave fewer Incorrect and more Adequate responses. Of the nearly 100 comparisons between deaf boys and girls, boys obtained higher scores that were also better scores somewhat more frequently than

girls, but the proportion of higher scores indicating poorer performance was about the same for boys and girls. Only one comparison between deaf boys and girls reached the .01 level D(32):CA 14 boys had higher Abstract scores on the Similarities test and three reached the .05 level.

VII. SUMMARY, CONCLUSIONS, AND IMPLICATIONS

This study was undertaken in an attempt to increase and refine understanding of cognitive development and performance of hearing and deaf children. The investigation was a modified longitudinal design in which the same subjects were given a substantial number of tests at two testing sessions separated by a period of two years. At the first session the hearing and deaf subjects were approximately 6, 9 and 12 years of age; at the second session they were approximately 8, 11 and 14. The design provided for information to be obtained on the performance of subjects over the years of elementary and junior high school attendance. It permitted short-term longitudinal comparisons on measures of cognitive performance of the hearing and deaf samples. It also permitted comparisons at selected ages among hearing subjects, among deaf subjects, and between hearing and deaf subjects. The performance of the hearing was taken as a standard to evaluate the performance of the deaf.

The hearing and deaf samples studied were, on the whole, of comparable age, socioeconomic status and intelligence. The hearing sample included 72 children, 24 in each age group. They were selected from regular public school classes and had no known handicapping conditions. Of the 60 deaf subjects, 24 were in the oldest, 19 in the middle, and 17 in the youngest age groups. For the several age groups, the mean hearing loss over the speech range in the ear with the most hearing was between 86 and 91 decibels. All deaf subjects selected for study were enrolled in special classes for the hearing impaired in one residential and two day schools. They were deaf from birth or before the age of two, and had no other known handicapping conditions.

Measures were selected to assess the performance of subjects (1) in different areas of cognition; (2) by language and nonlanguage techniques; (3) on information acquired incidentally or provided in the testing situation; and (4) with measures that, insofar as possible, were suitable for administration to both hearing and deaf children ranging in age over the elementary and junior high school years.

The specific tests administered were developed and used by other investigators. When it was necessary they were modified to be more appropriate for use with the present hearing and deaf samples. Special attention was given to developing techniques and to training examiners for work with the deaf to ensure the most adequate testing possible. With only a few exceptions, all tests were administered to each hearing age group at both testing sessions. For the deaf, many of the tests were too difficult for younger subjects. Thus, although all deaf age groups at both testing sessions were given the tests requiring nonlanguage responses, the youngest age group at the first session was not given the Piaget conservation tasks, and the youngest age group at both sessions and the middle age group at the first session were not given the vocabulary tests. The tests used, and the schedule of testing hearing and deaf age groups were presented in Table 3.2.

The three tests in which nonlanguage responses were required were (1) The Raven Progressive Matrices Test: Sets A, A_B, B are referred to as Part I, sets C, D, E are referred to as Part II, and the six sets are referred to as the Total test. (2) The Weigl-Goldstein-Scheerer Color Form Sorting Test in which the subject was first to sort 12 figures (three different forms of four colors each) on the category of his choice, and then to shift the category of sorting from color to form, or vice versa. (3) Gelb-Goldstein Color Sorting Test in which the subject sorted

skeins of yarn to a sample or a named color; and in which the subject was first to match yarns on hue or brightness and then to shift the dimension of matching. In addition to the classification of performance as Abstract or Concrete, quantitative scores were determined.

The four tasks taken from the work of Piaget and his associates were Conservation of Number, Conservation of Substance, Conservation of Weight, and Conservation of Volume. An effort was made to systematize testing procedures by using the same materials and providing pretest and test experiences as similar as possible for all subjects. As much systematization of the materials and procedures was introduced for each task as could be done without interfering with Piaget's clinical method. Test sessions were taped recorded, and, frequently both an observer and an examiner participated in the testing situation.

All of the conservation tasks that were used have been previously described in the literature. In this study, the essential aspects of testing on all tasks were a demonstration, a prediction elicited from the subject, a demonstrated verification, and an explanation of the prediction and/or verification for each transformation. Performances on all conservation tasks were classified into Piaget stages. For the conservation of number, substance and weight, it was possible to predetermine the transformations and the order of their presentation to the subjects. These were used to determine quantitative scores based on the rationale that each transformation could be considered a test item. No quantitative score was determined for the Conservation of Volume Task since the procedure followed in its administration was not sufficiently systematized to satisfy the rationale underlining the determination of the quantitative score.

Seven vocabulary measures assessed understanding and use of common words. A test of the knowledge of multiple meanings of words presented eight common words in a multiple-choice format, to be used with five different meanings to complete sentences. Since the test was originally constructed by Watts for use with English children it was necessary to modify the sentences so that all words were used in contexts that were meaningful to American children. Since the modified test was too difficult for use with the deaf subjects, a test appropriate for them was constructed using five words in 15 sentences selected on the basis of performance of 9- and 12-year old hearing subjects. Six vocabulary tests previously devised by Moran for use with normal and schizophrenic adults used the same 25 common words in tests of Definitions, Synonym Recall, Synonym Recognition, Sentence Construction, Similarities and Analogies. Ten of the words were thing referent, and 15 were nonthing referent.

In the body of the report have been presented results for the separate measures on a number of analyses quite systematically carried out and for the examination of specific characteristics of performance of the hearing and the deaf on certain of the tests. The systematic analyses were of longitudinal changes for hearing and deaf samples, and cross sectional age comparisons within and between hearing and deaf samples. Sex comparisons for both samples, and resident and day school comparisons for the deaf were made at all age levels tested. No attempt has been made to detail all of these findings here. However, the longitudinal changes and cross sectional age analyses are summarized and related to the predictions made in Section I. In addition some observations and results of the systematic and specific analyses are presented in the section on suggestions and implications for further work.

section on suggestions and implications for further work. This section, however, does not include all the suggestions and implications that have been considered earlier. In the more extensive presentation of results, discussions of finding on specific measures or types of measures used in this study have been included. They attempted to explain and to evaluate some of the findings, particularly as they related to relevant research, and should have some implication for further work.

Age Trends on Test Performance

In general, on practically all tests used in this investigation, older hearing subjects obtained better scores than younger, although the range of scores over the ages tested, and the highest level of performance attained varied among the several tasks. No age trends were apparent when very few responses occurred in a scoring category, e.g. the Number of Neologisms identified on the Synonym Recognition test. Some scores first increased and then decreased over the age range tested when they represented an intermedidate level of success (e.g. partially correct definitions) or when they reflected a developmental trend related to the task (e.g. number of responses on the Synonym Recall test). For the most part, the deaf tended to follow the same trends over the age range tested, but, with the exception of the Progressive Matrices, the Conservation of Number, and the Color Form Sorting tests, performance of the CA 14 deaf was considerably below the maximum performance of the hearing. The Color Sorting, Conservation of Substance, Conservation of Volume, Mulitple Meaning of Words and Analogies tests were much too difficult for the oldest deaf age group.

Age trends in scores for the hearing and deaf were also considered in comparisons between age groups separated by three years. Although

comparisons for the hearing were usually made between all possible ages (CA 6-9, CA 8-11, CA 9-12, and CA 11-14), the number of possible comparisons for the deaf was restricted by the number of age groups that were not administered certain of the tests.

Four comparisons could be made for both hearing and deaf on tests requiring nonlanguage responses. Of these only the Progressive Matrices showed significantly different scores over the same three-year periods for the hearing and the deaf. On the Color-Form Sorting Test the higher scores for the deaf occurred between CA 8-11 for the hearing, and between CA 9-12 and CA 11-14 for the deaf. On the Color Sorting Test the hearing showed significantly better scores between the oldest three-year span (CA 11-14); the deaf, on the test as a whole, showed no significant increases over any of the three-year periods compared.

Significant changes occurred on the conservation tasks for the hearing only at the youngest age span (CA 6-9). Comparisons between these ages were not possible with the deaf, but significant differences occurred for them between the other three-year age spans: on the Conservation of Number only between CA 11-14; on the Conservation of Substance between CA 8-11 and CA 9-12; and for the Conservation of Weight and the Conservation of Volume at the three age comparisons between CA 8-11, CA 9-12, and CA 11-14.

On the vocabulary test scores, the hearing showed significant differences between the age groups separated by three years through the age range of the study except in a few specific instances. For the most part, the deaf also showed significant differences in scores obtained at CA 11-14. However, examination of vocabulary scores that first increased and then decreased (e.g. partially correct definitions) suggested that the changes across a three-year span that occurred for the deaf at

older ages resembled those of the hearing at younger ages.

Age Comparisons between Hearing and Deaf

Age comparisons of the performance of the hearing and the deaf were based on the significance of the differences in the scores obtained at the same age levels and on the indentification of the hearing age group that attained scores most similar to the several deaf age groups tested on the various measures. Scores which increased and then decreased and on which no age trends were apparent for the hearing subjects over the age range tested were eliminated from this consideration since they confounded direct age comparisons.

Table 7.1 designates the hearing age group that obtained the score most similar to that of each of the several deaf age groups that were tested on the various measures. The scores of the hearing and deaf age groups were examined directly to determine the ages designated.

Scores of the deaf were inferior to those of the hearing at the same age with a few specific exceptions. The extent of the inferiority in performance varied somewhat among the tests and the age groups compared. Scores of the hearing and deaf were quite similar at all ages tested (except CA 9) on the Progressive Matrices Test, and at the older ages tested for the Color Form Sorting Test and the Conservation of Number. On the Progressive Matrices Test the performance of the deaf was at a relatively high level throughout the age range tested. On Part I (Sets A, A_B, B) of the six age levels compared, mean scores were not significantly different at five, and the actual mean scores were most similar to those of the same-aged hearing at four. On Part II (C, D, E) and Total the scores actual mean scores were only slightly less similar. On the Color Form Sorting test both hearing and deaf shifted from essentially concrete to essentially abstract performance during the age range studied. The later shift to

Table 7.1. Hearing Age Group with Score Most Similar to Deaf Age Groups Tested on the Several Measures.

	Deaf Age Groups					
CA:	14	12	11	9	8	6
Progressive Matrices						
Part I (A,A_B,B)	14	11	11	8	8	6
Part II (C,D,E)	12-14	12	9	below 9*	x	x
Total	14	11-12	9-11	below 9*	x	x
Color Form	11-14	9	below 6*	below 6*	below 6*	below 6*
Color Sorting						
Classification	6	below 6*	below 6*	below 6*	below 6*	below 6*
Quant.-I,III	6-9	6-9	9	below 6*	6	below 6*
Quant.-IIa,IIb,IV	below 6*	below 6*	below 6*	below 6*	below 6*	below 6*
Conservation Tasks						
Number Class.	11@	9	9	8	8	x
Number Quant.	11@	8-11	8-11	6	6	x
Substance Class.	6-8	6-8	6	below 6*	below 6*	x
Substance Quant.	6	6	below 6*	below 6*	below 6*	x
Weight Class.	8-11	9	6-8	below 6*	below 6*	x
Weight Quant.	8,11,14	9-12	9-11	9	below 6*	x
Volume Class.	8	11	6	below 6*	below 6*	x
Multiple Meanings	below 9*	below 9*	below 9*	x	x	x
Moran Total Words						
Definition (-)	6-8	below 6*	below 6*	x	x	x
Definition (+)	6-8	below 6*	below 6*	x	x	x
Recall # Synonyms	9-11	8	6	x	x	x
Recall % Synonyms	9	8-9	6-8	x	x	x
Recognition # Syn.	below 6*	below 6*	below 6*	x	x	x
Similarities (-)	below 8*	8	below 8*	x	x	x
Similarities Abst.	8-9	8-9	8-9	x	x	x
Sentence	8-9	8	6	x	x	x
Analogies	below 8*	below 8*	below 8*	x	x	x
Moran Thing Ref. Words						
Definition (-)	below 6*	below 6*	below 6*	x	x	x
Definition (+)	below 6*	below 6*	below 6*	x	x	x
Recall # Synonyms	12	8	6-8	x	x	x
Recall % Synonyms	9-12	9	8	x	x	x
Recognition # Syn.	6	6	6-8	x	x	x
Similarities (-)	8	8	8	x	x	x
Similarities Abst.	6-8	6-8	6-8	x	x	x

Table 7.1. (continued) Hearing Age Group with Score Most Similar to Deaf Age Groups Tested on the Several Measures.

	Deaf Age Groups					
CA:	14	12	11	9	8	6
Moran Nonthing Ref.						
Definitions (-)	6-8	6-8	6	x	x	x
Definitions (+)	8-9	6-8	6	x	x	x
Recall # Synonyms	8-9	8	6	x	x	x
Recall % Synonyms	8-11	8-11	6-8	x	x	x
Recognition # Syn.	below 6*	below 6*	below 6*	x	x	x
Similarities (-)	8	11	8	x	x	x
Similarities Abst.	8-9	8-9	below 8*	x	x	x

x - both deaf and hearing age groups not tested
* - youngest age group tested
@ - oldest age group tested

abstract performance by the deaf than by the hearing, is reflected in the significant difference in scores at one age level. The oldest deaf tested all understood the Conservation of Number.

The performance of the deaf on the total Color Sorting Test showed relatively little change over the age range tested. Thus, although the deaf at all ages most resembled the hearing at or below six years, mean scores were significantly different only at the older ages when the hearing exhibited substantially more abstract performances and better quantitative scores than at the younger ages. The amount of inferiority of the performance of the deaf varied on the separate conservation tasks. Although the performances of the hearing and the deaf at the same ages tended to differ, they were not significantly different at the older ages on the Conservation of Number and at the first testings on the Conservation of Weight. The Conservation of Volume task was too difficult for the

younger hearing and for the deaf at all ages. Performance on the Conservation of Number Task was at a high level for both deaf and hearing. On the Conservation of Weight Task, each consecutively older deaf age group received higher scores, but for the hearing, scores at the second testings were higher than at the first, so that no progression of scores with increasing age was found.

On tests of knowledge and use of common vocabulary, the deaf were extremely inferior to the hearing. Nearly all comparisons of performance at the same ages were significantly different, and those that were not reached the .05 level of confidence or were found at the CA 12 age group on the Similarities and Synonym Recall test. Both of these tests were somewhat more difficult for the hearing than the other vocabulary measures. For the most part the CA 14 deaf resembled the performance of hearing age groups six to eight or more years younger. Only on the Recall of Synonyms was the inferiority as little as three years. Since in a number of instances the scores of the deaf are considerably below those of the youngest hearing age group tested, the estimated years of inferiority are probably minimal on these vocabulary tests. It should be recalled that the vocabulary tests selected for this study were not measures of size or extent of the subjects' vocabulary, but were concerned with their use and understanding of very common words.

The degree of inferior performance of the deaf was least on the Progressive Matrices test throughout the age range, and on the Conservation of Number and Color Form Sorting tests at the older ages. The inferior performance was greatest for the vocabulary measures throughout the age range tested, and for the Color Sorting test and the Conservation of Substance at the older ages. On the Moran tests, the somewhat

greater inferiority of the deaf on thing than on nonthing referent words was related to the difference found in performance on these categories of words by the hearing and not by the deaf.

Predictions Related to Age Comparisons

On one major and four corallary predictions dealing with performance of the hearing and the deaf, age comparisons supply evidence.

Prediction 1. Deaf Subjects at each age level are inferior to hearing children in cognitive performance, and they become progressively more inferior at the older ages. While this prediction was true for most measures it was not upheld on the Progressive Matrices test at the several age levels, nor on the Color Form Sorting and the Conservation of Number tests at the oldest ages. On the last two tests, rather than the performance of the deaf being more inferior it was most similar to the hearing at the oldest ages. However, the inferior performance of the deaf was more pronounced at the oldest ages on tests in which the hearing, but not the deaf, had relatively good performance at the older ages, i.e. Analogies, Color Sorting (with the exception of Experiment III) and Conservation of Substance.

Prediction 1.1 Inferiority of the deaf subjects is less when the measures are based on information presented in controlled testing situations. This prediction was supported throughout the age range only by the findings on the Progressive Matrices test, and at the older ages on the Color Form Sorting test. However, the prediction was not supported by the results on the Color Sorting test. On this test differences in the performance of the hearing and deaf were found as great as those on any of the other tests. The Color Sorting test was originally classified as based on information both provided in a controlled test situation and attained incidentally in day to day experiences. The

results may reflect ambiguity in the criterion for selection of the tests, or in the content of this test in relation to the criterion.

Prediction 1.2 Inferiority of the deaf subjects is greater on measures that are based on concepts and generalizations usually attained in everyday experiences. This prediction was supported by the results on the vocabulary measures, but the conservation tasks also classified as based on information attained in everyday experiences varied in the extent of inferiority in relation to the difficulty of the task for the deaf.

Prediction 1.3 Inferiority of the deaf subjects is greater on measures in which language responses are a necessity. This prediction was partially supported. Although the inferiority of the deaf on vocabulary tests demanding language responses was as great as that on any other tests, the inferiority on the conservation tasks which also demanded language responses, varied with the particular task. In addition, the inferiority on Color Sorting (with the exception of Experiment III) was at the same level as on the vocabulary tests.

Prediction 1.4 Inferiority of the deaf subjects is greater in any area when the task is more complex. This prediction seems to be supported by the tests dealing with classification and vocabulary, but not by the other tests. For example, the deaf were more inferior on classification tests dealing with hue and brightness than with color alone; in the construction of sentences using more stimulus words; and in the analogies test.

These several predictions are all partially supported, but with certain exceptions. Possible causes for the exceptions may be sought in factors such as the contamination of the criteria in the actual selection of the tests used, the varying, the uncontrolled difficulty of

the tests, the degree of familiarity with certain of the test areas, the adequacy of the testing procedures used with the deaf. It is important that the factors related to the performance of the deaf be identified since they may well supply some clues to bring the deaf to a greater use of their intellectual potential.

Longitudinal Change

Comparisons in the performance of the same subjects between the first and second testing were possible for the hearing subjects at CA 6-8, CA 9-11, and CA 12-14. The number of comparisons for the deaf varied and were more limited. Three comparisons were made for the deaf on tests classified as needing nonlanguage responses, two comparisons were made on the Piaget conservation tasks (between CA 9-11 and CA 12-14), and only one comparison on the vocabulary measures (between CA 12-14). The significance of the changes in scores or distributions of performances of the same subjects between sessions were indicated in the discussion of each measure.

Patterns of the level of significance of changes in scores between the first and second testing differed for the hearing and deaf age groups regardless of the level of achievement of the deaf. Of the three tests on which the final performance of the hearing and deaf was quite similar, different patterns of change occurred. On the Conservation of Number Task the significant increase for the hearing was at the youngest and for the deaf at the oldest age group comparison. On Part I (Sets A, A_B, B) of the Progressive Matrices between CA 6-8 occurred the only instance in which a significant change was at the same age level on the same test score for both the hearing and the deaf. On this score, however, the middle and oldest hearing age groups did not show significant increments between testings, but the deaf did. Although on Color Form

Sorting none of the hearing or deaf groups increased significantly between testing sessions, the earlier, but less dramatic shift to Abstract performance by the hearing groups was reflected in the changes in scores between hearing CA 9-11 reaching the .05 level of confidence while the change in scores between these ages was below this level for the deaf.

On the scores in which the best performance of the deaf was considerably below that of the hearing, the patterns of change in scores between testing sessions also were different for the hearing and deaf. On the Color Sorting test the increase in both classification and quantitative scores of the hearing tended to be significant at the middle and the oldest age comparisons, but with one exception none of the scores for the deaf increased significantly. On the conservation tasks the hearing consistently showed significant increases in performance between CA 6-8, and with the exception of the conservation of weight they showed significant increments only for the youngest age group. No direct comparisons could be made with the performance of the deaf at the CA 6-8. However, the only significant changes in scores for the deaf occurred on the conservation of number (on which they had a high level of performance) for the oldest age group.

On the vocabulary measures the number of significant changes in scores that occurred for the oldest age group was approximately equal for the hearing and the deaf. This was the only deaf age group on which longitudinal comparisons could be made. The hearing, however, showed about as many significant changes for the middle age group, and about twice as many for the youngest age group. Thus on the vocabulary measures, the greatest number of significant changes occurred for the hearing at the early years. Because of the low level of performance of the oldest deaf on the vocabulary tests, substantial increments in performance are

necessary if they are ever to achieve at a satisfactory level on these vocabulary tests concerned with very common words. On these tests the inferior performance of the deaf was accentuated by their not having shown more significant change than the hearing at the older ages.

Prediction on Longitudinal Change

One prediction was initially made on longitudinal change:

Prediction 2. In the longitudinal development of cognitive performance, deaf children show less significant increase in performances over a two-year period than hearing children. This prediction was probably true, although it could not be evaluated at all ages for all tests. Improvement in performance appeared later for the deaf than for the hearing on some scores (particularly on the Incorrect and Correct definitions for the total and nonthing referent words on the Definitions test, and for the number of Synonyms on the thing referent words, and in the quantitative score on Experiments I and III of the Color Sorting test) and on others at CA 14 the performance of the deaf had not yet shown substantial improvement (e.g. Multiple Meaning of Words, Analogies, Experiments IIa, IIb, IV on the Color Sorting Test, and the Conservation of Substance). The data suggest that the patterns of improvement in performance, when improvement did occur tended to be similar to those of considerably younger hearing children.

Sex Comparisons

Throughout the study no essential differences were found in the performance of boys and girls in the same age groups. This held for both hearing and deaf. Although hearing girls obtained a slightly higher proportion of better scores than hearing boys in some 300 comparisons, the six instances in which girls obtained significantly better scores were found at different ages and on several tests. In two comparisons

boys obtained significantly higher scores, and in ten others they reached the .05 level of confidence. The better performances of boys were scattered throughout the age groups and tests.

In some 200 comparisons, deaf boys received a higher proportion of better scores than deaf girls but in only one instance did the difference reach the .01 level of confidence. The ten comparisons for the deaf that reached the .05 level were not concentrated at any age or test, and the better scores were obtained by both boys and girls.

Day and Resident School Comparisons

Performance of day and resident school deaf subjects at the same age levels was similar on all tests. The day school subgroups obtained better scores in just over half of some 200 comparisons. Eight reached the .01 and fourteen the .05 level of confidence. Day school subgroups obtained the better scores in three of the former and ten of the latter. Only on the Progressive Matrices and the Analogies tests did the day school subgroups quite consitently obtain better scores, but in no instances did the mean difference reach the .05 level of confidence. Neither the resident nor the day school subgroups consistently received better scores on the several tests at any age level.

Performance of subjects in resident schools has often been reported below that of subjects in day schools. The similarity of their performance found in the present study is not merely the result of the small number of subjects in the subgroups, since each subgroup obtained about half of the better scores, and inspection showed that the mean scores at each age level were very similar for the two subgroups. The reasons for the lack of difference found between resident and day school subjects are not now known, but should be explored. The similarity of their performance is probably partially related to the fact that the

subjects in both types of schools were profoundly deaf. In an earlier study Templin (1954a, 1954b) found the degree of hearing loss a more important factor in cognitive performance of the hearing impaired than day or resident school attendance. The similarity of performance may partially be explained as an indication of some diffusion of the more challenging Zeitgeist in American schools since World War II to the educational environment of the deaf.

Effect of First Testing Session

In general older subjects tended to receive higher achievement and lower error scores than younger subjects on all measures. In two instances in which age groups were separated by one year the younger age group was at its second and the older age group at its first testing session (CA 8-9 and CA 11-12). If in either comparison the younger age group obtained the better test score on a particular test, this could be interpreted as the result of earlier experience with the test. If in both comparisons the younger age group received the better test score, this interpretation would be strengthened since the same subjects would have obtained the poorer score at their first testing (as older subjects in the CA 8-9 comparisons) and the better score at their second testing (as younger subjects in the CA 11-12 comparisons). The interpretation would also be strengthened if the younger age groups obtained better scores in tests classified as based on information provided in a controlled testing situation.

Comparisons of the performances of the CA 8-9 and the CA 11-12 age groups were examined for as many tests as possible. If the CA 6 age group had not been given a test a comparison(s) was not made between CA 11-12. Examination of the direction of the better mean score, and of the levels of confidence of the differences between scores suggested

that for both deaf and hearing the higher scores obtained by younger age groups were concentrated in tests originally selected as measuring incidental learning.

The younger hearing age group obtained the higher scores much more frequently than the younger deaf age groups. In approximately half the comparisons for the hearing, the younger group obtained the higher score: 12 in the CA 8-9 and 13 in the CA 11-12 comparisons. The scores were higher at the .01 level in only two instances (classification and quantitative scores on the Conservation of Weight for the CA 8-9 comparison) and in five instances at the .05 level of confidence. However, in nine instances the better scores were obtained by the younger age group in both comparisons for the hearing.

Since the CA 6 deaf age group was not administered most of the tests, few comparisons between CA 8-9 were possible, but those at CA 11-12 were more frequent than for the hearing. In the latter comparisons, the younger deaf received higher scores in four. Only once did the younger age gropp receive the higher score in both the CA 8-9 and the CA 11-12 comparisons.

Although the results were not clear-cut, they suggested that the hearing were profiting from previous experience - either in or out of the testing situation - to a greater extent than the deaf.

Teacher Perception of Students

Teachers of hearing children perceived their students at the older ages as more curious and less dependent in solving problems in which either language or the manipulation of materials were major components. Teachers of deaf children tended to perceive their students as less curious and more dependent in such tasks at the older ages. Whether this was an accurate evaluation of the behavior of the subjects is not

known, since the rating scale used reflects the teacher's perception of the behavior of each child. However, if this is the perception that teachers do have of the behavior of their deaf students, it may contribute, particularly at the secondary level, to the long-recognized problems of low achievement of deaf children. If a teacher perceives her pupils as dependent and lacking in curiosity, it is reasonable to expect that such behavior would be fostered in the classroom unless special effort was made to create a challenging and stimulating learning environment. The differences in the perception of teachers of their hearing and deaf students, however, is an important and relevant consideration in the preparation and inservice education of teachers of the deaf.

The Deaf as Subjects for Research

It is very difficult to obtain a sample of school age deaf subjects for study even if only such gross factors as age, degree and age of onset of hearing impairment are controlled. If control of important variables such as etiology and type of hearing impairment, intellectual ability, educational setting and specific skills or abilities are added, locating a satisfactory sample becomes increasingly difficult. Information on individuals pertinent for sample selection is often lacking in readily available records, and sometimes can be obtained only after a substantial period of time and sometimes not at all. However, deaf subjects, in part because of the smaller number of programs available than for the hearing, tend to remain in their educational settings, and thus provide a relatively stable sample for longitudinal investigation.

In any study of deaf children, problems associated with testing techniques and methodology are in themselves worthy of investigation. While the responses of the deaf in this report represent a satisfactory example of their performance, it is likely that deaf children with more

oral backgrounds would have responded somewhat differently on some tests.

Performance in any testing situation is influenced by past everyday experiences. If the observations from this study are reliable, it may be that deaf children have more experiences in imitative than in exploratory and creative approaches. On the Piaget conservation tasks it was less difficult to bring deaf subjects to describe what had occurred than to predict what would occur, and even more difficult to extract an explanation. It cannot be known from this study if their everyday and educational experiences or their understanding of the tasks are more reflected in this behavior. Because of the performance of the deaf on some tasks, however, it is more likely a reflection of their experience. In any event such behavior especially penalizes the deaf in our current emphasis upon creativity, imagination and ingenuity.

The deaf have long been known to be deficient in language. Nevertheless, as in parts of this study, spoken language, writing and reading are often integral parts of the testing procedure. This probably overemphasizes the known language inferiority and certainly does not permit an uncontaminated evaluation of the role of language deficiency in the testing. If the cognitive behavior of the deaf is really to be understood, there is a need to study systematically the performance and learning of the deaf with techniques that control the role of language and at the same time do not distort the behavior being studied.

Suggestions and Implications for Further Work

The specific value that the findings of this study may have for further work will be determined only as they are used in research and instructional planning and action. Nevertheless, some findings and suggestions whose relevance for research and instruction seem quite immediately apparent are presented here.

1. Patterns of longitudinal change differed for the hearing and the deaf. Although evidence from all longitudinal data were not completely consistent, it suggested that changes in performance for the deaf, when they were found, tended to occur at older ages and to resemble those of considerably younger hearing children. It also suggested that, compared to the hearing, the deaf demanded a longer period of time in which to achieve a high level of performance on easier tests, and that, on some harder tests, the rate of change for the deaf was such that at the older ages no substantial improvement was yet apparent.

2. Although the deaf were inferior to the hearing at the same age on most of the cognitive measures, they were similar throughout the age range on the Progressive Matrices Test, and at the older ages tested on the Color Form Sorting Test and the Conservation of Number Task.

3. The same deaf children when compared to the hearing varied considerably in the level of their performance on different tests. On the basis of the present study the differences found cannot be attributed to language or nonlanguage responses, to the information used in the tests being classified as presented in a controlled testing situation or as acquired through everyday experience, nor to the particular cognitive area tested. Identification of factors associated with this varied performance could be of particular value for the improvement of educational procedures with the deaf.

4. The language deficit of the deaf has been shown to exist in their knowledge and use of very common words. It was found that at the oldest age studied the deaf are not inferior in performance on all tasks that employ language responses.

5. The difficulty of the deaf with abstract problems was reemphasized. Characteristics of performance on the tests offered suggestions for further study. The deaf tended to respond with an association to a

specific word in an analogy problem rather than to the relationship that is basic in analogy; the tendency of the deaf to shift the category of sorting on the Color Form Sorting test resembled that of the hearing if the initial sorting was on the basis of form, but not if their initial sorting was on color or mixed categories; the deaf tended to perseverate in their responses on a number of tests.

6. Performance of the deaf in the construction of sentences tended to become more inferior to that of the hearing when the number of words to be incorporated in the sentence was increased. The effect of the complexity of a task in several cognitive areas should be experimentally investigated.

7. The sequence of the understanding of conservation has been quite definitely established by many investigators as number, substance, weight, and volume. In this study the established sequence was found for the hearing subjects, but the order of substance and weight was reversed for the deaf. This change more likely reflects the effect of characteristics of the testing situations and/or past experiences and behavior of the subjects rather than a difference in cognitive functioning of the deaf.

8. Findings from this study suggest that consideration should be given to environmental factors as they relate to the cognitive behavior of the deaf: e.g. the lack of difference in performance of the resident and day school subjects, the possible differential effect of early testing or incidental learning on test performance, the teachers' perception of curiosity and dependency in their students.

9. The use of the quantitative scores devised for tests on which performance is usually classified should be further explored with a different sample if their worth is to be determined.

10. There is need for extensive experimental study of language, cognition and learning of deaf children. It is only through systematic, concentrated and continued study of specific functions that the behavior of the deaf will be better understood.

Conclusion

The period since the planning of this study initiated in 1958 to the present has been marked by increased interest and activity in the areas of language and cognition of deaf children. A number of research projects have been published or are under way: conferences on problems of language development and learning of the deaf have been held; there are evidences of attempts at rethinking the entire field of the education of deaf children. Unfortunately the planning of this study was done too early to benefit from the more broadly based current discussions, knowledge, and technology. However, the findings of this study are relevant for current research and educational activities with the deaf.

APPENDIX A

Table A-I-1. t Values, Based on a Two-tailed Distribution, at the .01 and .05 Levels of Confidence for Selected N's Used in this Investigation.

	Level of Confidence	
N	.01	.05
17	2.95	2.13
19	2.90	2.11
24	2.82	2.07
36	2.72	2.03
38	2.72	2.03
41	2.70	2.02
43	2.70	2.02
48	2.69	2.01

Table A-IV-1. Raven's Progressive Matrices Test: Part A,A_B,B; Part C,D,E; and Total. Hearing and Deaf Age Groups by Sessions. Mean Scores and Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
HEARING							
A,A_B,B							
H(1)	24	16.22	3.83	24	23.85	5.23	5.78**
H(2)	24	25.52	6.52	24	27.11	7.06	0.81
H(3)	24	30.27	4.49	24	32.03	3.75	1.47
C,D,E							
H(2)	24	11.21	6.66	24	15.71	8.06	2.11*
H(3)	24	19.87	5.95	24	24.08	4.74	2.71**
TOTAL							
H(2)	24	36.74	12.10	24	42.83	13.00	1.68
H(3)	24	50.17	9.78	24	56.13	7.30	2.39*

Table A-IV-1 (continued). Raven's Progressive Matrices Test: Part A, A_B B; Part C, D, E; and Total. Hearing and Deaf Age Groups by Sessions. Mean Scores and Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
DEAF							
A,A_B,B							
D(1)	17	15.05	3.63	17	21.87	6.74	3.65**
D(2)	19	20.25	5.42	19	27.25	4.89	4.14**
D(3)	24	26.44	6.05	24	32.19	2.75	4.23**
C,D,E							
D(2)	19	6.16	4.89	19	12.68	7.07	3.31**
D(3)	24	18.04	8.76	24	21.29	4.78	1.59
TOTAL							
D(2)	19	26.41	5.71	19	39.92	8.62	5.65**
D(3)	24	44.49	10.53	24	53.50	6.95	3.12**

Table A-IV-2. Raven's Progressive Matrices Test: Part A,A_B,B; Part C,D,E; and Total. Hearing Boys and Girls by Age Groups. Mean Scores and Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
A,A_B,B							
H(11)	12	17.25	3.60	12	15.16	3.83	1.36
H(12)	12	23.24	6.02	12	24.41	4.50	0.54
H(21)	13	25.61	7.25	11	25.36	5.89	0.09
H(22)	13	28.61	4.74	11	25.27	8.93	1.16
H(31)	12	29.90	5.62	12	30.57	3.13	0.36
H(32)	12	31.40	4.73	12	32.57	2.32	0.50
C,D,E							
H(21)	13	12.54	6.70	11	9.64	6.38	1.07
H(22)	13	16.85	9.43	11	14.36	6.25	0.22
H(31)	12	18.17	6.81	12	21.58	4.62	1.44
H(32)	12	23.08	4.34	12	25.08	5.11	1.09
TOTAL							
H(21)	13	38.14	13.40	11	35.00	10.87	0.62
H(22)	13	45.45	13.90	11	39.63	11.60	1.10
H(31)	12	48.06	11.50	12	52.15	7.53	1.02
H(32)	12	54.48	8.37	12	57.64	5.99	1.06

Table A-IV-3. Raven's Progressive Matrices Test: Part I (Sets A, A_B, B); Part II (C,D,E); and Total. Deaf Boys and Girls by Age Groups. Mean Scores and Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Part I (Sets A, A_B, B)							
D(11)	13	15.38	3.95	4	14.00	3.16	0.64
D(12)	13	23.76	6.44	4	15.75	3.30	2.43*
D(21)	10	20.80	5.94	9	19.66	5.29	0.43
D(22)	10	28.80	3.85	9	25.55	5.55	1.50
D(31)	15	25.48	6.52	9	28.00	5.12	0.99
D(32)	15	32.55	2.67	9	31.55	2.92	0.85
Part II (Sets C,D,E)							
D(21)	10	8.20	5.53	9	3.89	2.15	2.58*
D(22)	10	13.80	3.21	9	11.44	5.03	1.23
D(31)	15	18.93	9.92	9	16.56	6.67	0.63
D(32)	15	21.87	4.66	9	20.33	5.07	0.75
TOTAL							
D(21)	10	29.00	4.88	9	23.55	5.61	2.26*
D(22)	10	42.60	8.11	9	37.00	8.54	1.14
D(31)	15	44.42	10.89	9	44.55	10.54	0.03
D(32)	15	54.42	6.80	9	51.88	7.32	0.86

Table A-IV-4. Raven's Progressive Matrices Test: Part I (Sets A, A_B, B); Part II (C,D,E); and Total. Deaf Resident and Day School Subjects by Age Groups. Mean Scores and Significance of Differences.

	Day School			Resident School			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Part I (Sets A, A_B, B)							
D(11)	8	16.37	4.50	9	13.89	2.62	1.41
D(12)	8	25.50	7.40	9	18.69	4.77	2.71*
D(21)	6	20.17	7.47	13	20.31	4.73	0.05
D(22)	6	29.00	3.90	13	26.46	5.22	1.06
D(31)	13	25.69	7.17	11	27.27	4.58	0.63
D(32)	13	32.61	2.63	11	31.64	2.91	0.86
Part II (Sets C,D,E)							
D(21)	6	8.33	7.61	13	5.15	2.41	1.40
D(22)	6	14.83	5.49	13	11.69	3.40	1.54
D(31)	13	19.85	9.91	11	15.91	7.03	1.10
D(32)	13	21.85	3.66	11	20.64	5.80	0.62
TOTAL							
D(21)	6	28.50	4.46	13	25.46	6.25	1.06
D(22)	6	43.83	8.86	13	38.15	8.23	1.37
D(31)	13	45.54	11.76	11	43.18	9.26	0.54
D(32)	13	54.46	5.14	11	52.27	8.75	0.76

Table A-IV-5 Raven's Progressive Matrices Test: Part A,A_B,B; Part C,D,E; and Total. t Values between Sessions, and Selected Age and Sex Groups for Hearing, Deaf, and Deaf Versus Hearing.

Part A, A_B, B

HEARING

Session Comparisons

	CA	t
H(11)-H(12)	6-8	5.78**
H(21)-H(22)	9-11	0.81
H(31)-H(32)	12-14	1.47

Age Group Comparisons

	CA	t
H(12)-H(21)	8-9	0.98
H(22)-H(31)	11-12	1.85
H(11)-H(21)	6-9	6.04**
H(12)-H(22)	8-11	1.82
H(21)-H(31)	9-12	2.93**
H(22)-H(32)	11-14	3.02**

DEAF

Session Comparisons

	CA	t
D(11)-D(12)	6-8	3.65**
D(21)-D(22)	9-11	4.14**
D(31)-D(32)	12-14	4.23**

Age Group Comparisons

	CA	t
D(12)-D(21)	8-8	0.21
D(22)-D(31)	11-12	0.47
D(11)-D(21)	6-9	4.41**
D(12)-D(22)	8-11	2.76*
D(21)-D(31)	9-12	4.62**
D(22)-D(32)	11-14	4.19**

Boy-Girl Com

DEAF VERSUS HEARING

Combined Sexes:
Age Group Comparisons

	CA	t
D(11)-H(11)	6-6	0.98
D(11)-H(32)	6-14	14.27**
D(12)-H(11)	8-6	3.40**
D(12)-H(12)	8-8	1.06
D(12)-H(32)	8-14	6.16**
D(21)-H(11)	9-6	2.82**
D(21)-H(21)	9-9	2.83**
D(21)-H(32)	9-14	8.12**
D(22)-H(11)	11-6	8.29**
D(22)-H(22)	11-11	0.07
D(22)-H(32)	11-14	3.62**
D(31)-H(11)	12-6	7.00**
D(31)-H(31)	12-12	2.49*
D(31)-H(32)	12-14	3.86**
D(32)-H(11)	14-6	16.64**
D(32)-H(32)	14-14	0.17

Boys:
Age Group Comparisons

	CA	t
D(11)-H(11)	6-6	1.23
D(12)-H(12)	8-9	0.79
D(21)-H(21)	9-9	1.70
D(22)-H(22)	11-11	0.10
D(31)-H(31)	12-12	1.86
D(32)-H(32)	14-14	0.80

Girls:
Age Group Comparisons

	CA	t
D(11)-H(11)	6-6	0.54
D(12)-H(12)	8-8	3.51**
D(21)-H(21)	9-9	2.25*
D(22)-H(22)	11-11	0.08
D(31)-H(31)	12-12	1.43
D(32)-H(32)	14-14	0.89

Table A-IV-5 (continued). Raven's Progressive Matrices Test: Part A, A_B, B; Part C,D,E; and Total. t Values between Sessions, and Selected Age and Sex Groups for Hearing, Deaf, And Deaf Versus Hearing.

Part C,D,E

HEARING

Session Comparisons

	CA	t
H(21)-H(22)	9-11	2.11*
H(31)-H(32)	12-14	2.71**

Age Group Comparisons

	CA	t
H(21)-H(31)	9-12	4.78**
H(22)-H(31)	11-12	2.04*
H(22)-H(32)	11-14	4.39**

DEAF

Session Comparisons

	CA	t
D(21)-D(22)	9-11	3.31**
D(31)-D(32)	12-14	1.59

Age Group Comparisons

	CA	t
D(21)-D(31)	9-12	5.28**
D(22)-D(31)	11-12	3.06**
D(22)-D(32)	11-14	4.75**

DEAF VERSUS HEARING

Combined Sexes:
Age Group Comparisons

	CA	t
D(21)-H(21)	9-9	2.77**
D(21)-H(32)	9-14	12.14**
D(22)-H(22)	11-11	1.29
D(22)-H(32)	11-14	6.31**
D(31)-H(31)	12-12	0.85
D(31)-H(32)	12-14	2.97**
D(32)-H(32)	14-14	2.03*
D(32)-H(21)	14-9	6.03**

Boys:
Age Group Comparisons

	CA	t
D(21)-H(21)	9-9	1.66
D(22)-H(22)	11-11	0.97
D(31)-H(31)	12-12	0.23
D(32)-H(32)	14-14	0.69

Girls:
Age Group Comparisons

	CA	t
D(21)-H(21)	9-9	2.42*
D(22)-H(22)	11-11	1.13
D(31)-H(31)	12-12	2.05*
D(32)-H(32)	14-14	2.23*

Table A-IV-5 (continued). Raven's Progressive Matrices Tests: Part A,A_B,B; Part C,D,E; and Total. t Values between Sessions, and Selected Age and Sex Groups for Hearing, Deaf, and Deaf Versus Hearing.

Total Test

HEARING

Session Comparisons

	CA	t
H(21)-H(22)	9-11	1.67
H(31)-H(32)	12-14	2.39*

Age Group Comparisons

	CA	t
H(21)-H(31)	9-12	4.21**
H(22)-H(31)	11-12	2.21*
H(22)-H(32)	11-14	4.36**

DEAF

Session Comparisons

	CA	t
D(21)-D(22)	9-11	5.65**
D(31)-D(32)	12-14	3.12**

Age Group Comparisons

	CA	t
D(21)-D(31)	9-12	6.72**
D(22)-D(31)	11-12	1.53
D(22)-D(32)	11-14	5.73**

DEAF VERSUS HEARING

Combined Sexes:
Age Group Comparisons

	CA	t
D(21)-H(21)	9-9	3.40**
D(21)-H(32)	9-14	10.39**
D(22)-H(22)	11-11	0.84
D(22)-H(32)	11-14	1.28
D(31)-H(31)	12-12	1.99
D(31)-H(32)	12-14	4.44**
D(32)-H(32)	14-14	1.76
D(32)-H(21)	14-9	5.89

Boys:
Age Group Comparisons

	CA	t
D(21)-H(21)	9-9	2.05*
D(22)-H(22)	11-11	0.58
D(31)-H(31)	12-12	0.84
D(32)-H(32)	14-14	0.02

Girls:
Age Group Comparisons

D(21)-H(21)	9-9	2.85*
D(22)-H(22)	11-11	0.56
D(31)-H(31)	12-12	1.93
D(32)-H(32)	14-14	1.98

Table A-IV-6. Raven's Progressive Matrices Test: Sets A, A_B, B, C, D, E. Hearing and Deaf Age Groups by Testing Sessions, Comparison of Means and Significance of Differences.

	Hearing			Deaf			
	N	$\overline{X}$	SD	N	$\overline{X}$	SD	t
SET A							
(11)	24	7.62	2.02	17	7.76	1.82	0.23
(12)	24	9.41	1.61	17	8.53	1.77	1.66
(21) (21)	24	9.88	2.11	19	8.42	2.10	2.26*
(22)	24	9.76	1.84	19	10.11	1.88	0.61
(31)	24	10.42	1.72	24	9.42	1.76	1.99
(32)	24	10.33	1.16	24	10.29	0.99	0.13
SET A_B							
(11)	24	5.08	1.53	17	4.47	1.94	1.13
(12)	24	8.08	2.26	17	7.06	2.73	1.31
(21)	24	8.63	2.63	19	6.68	2.47	2.48*
(22)	24	9.56	2.53	19	9.47	2.29	0.12
(31)	24	10.71	1.63	24	9.37	2.39	2.27*
(32)	24	11.25	1.15	24	11.17	1.13	0.24
SET B							
(11)	24	3.50	1.47	17	2.82	1.07	1.62
(12)	24	6.33	2.53	17	6.29	3.25	0.04
(21)	24	6.84	2.90	19	5.16	2.43	0.12
(22)	24	7.64	3.43	19	7.68	2.71	0.04
(31)	24	9.12	2.19	24	7.62	3.07	1.95
(32)	24	10.42	1.88	24	10.71	1.30	0.47
SET C							
(21)	24	5.00	3.10	19	3.42	2.39	1.83
(22)	24	6.12	2.91	19	5.68	2.63	0.52
(31)	24	8.12	1.96	24	7.12	2.72	1.46
(32)	24	9.25	1.85	24	8.71	1.76	1.04
SET D							
(21)	24	4.60	3.20	19	2.00	1.97	3.10**
(22)	24	6.28	3.58	19	5.21	2.68	1.08
(31)	24	7.62	2.76	24	7.32	2.93	0.36
(32)	24	8.92	2.38	24	8.46	1.79	0.76
SET E							
(21)	24	1.28	1.95	19	0.74	1.40	1.02
(22)	24	2.02	2.50	19	1.78	1.27	0.46
(31)	24	3.91	2.84	24	3.83	3.63	0.08
(32)	24	5.71	2.55	24	4.08	2.18	2.38*

Table A-IV-7. Weigl-Goldstein-Scheerer Color Form Sorting. Number of Performances Classified Concrete and Abstract. Hearing and Deaf by Age Groups.

	HEARING					DEAF				
		Concrete	Abstract				Concrete	Abstract		
	N		Total	Spontaneous	Induced	N		Total	Spontaneous	Induced
COMBINED SEXES										
(11)	24	15	9	8	1	17	15	2	1	1
(12)	24	14	10	8	2	17	17	0	0	0
(21)	24	9	15	12	3	19	18	1	1	0
(22)	24	2	22	14	8	19	15	4	2	2
(31)	24	5	19	15	4	17*	3	14	9	5
(32)	24	1	23	22	1	24	4	20	19	1
BOYS										
(11)	12	9	3	3	0	13	12	1	1	0
(12)	12	8	4	4	0	13	13	0	0	0
(21)	13	6	7	6	1	10	10	0	0	0
(22)	13	0	13	9	4	10	8	2	1	1
(31)	12	5	7	5	2	12*	3	9	6	3
(32)	12	1	11	10	1	15	4	11	11	0
GIRLS										
(11)	12	6	6	5	1	4	3	1	0	1
(12)	12	6	6	4	2	4	4	0	0	0
(21)	11	3	8	6	2	9	8	1	1	0
(22)	11	2	9	5	4	9	7	2	1	1
(31)	12	0	12	10	2	5*	0	5	3	2
(32)	12	0	12	12	0	9	0	9	8	1
DAY SCHOOL										
(11)						8	7	1	0	1
(12)						8	8	0	0	0
(21)						6	5	1	1	0
(22)						6	5	1	1	0
(31)						12*	1	11	6	5
(32)						13	2	11	11	0
RESIDENT SCHOOL										
(11)						9	8	1	1	0
(12)						9	9	0	0	0
(21)						13	13	0	0	0
(22)						13	10	3	1	2
(31)						5*	2	3	3	0
(32)						11	2	9	8	1

* Incomplete data for some subjects.

Table A-IV- 8 . Gelb-Goldstein Color Sorting. Number of Concrete and Abstract Performances on Total Test. Hearing and Deaf.

	Combined Sexes		Boys		Girls		Day School		Resident School	
	Con.	Abs.	Con.	Abs.	Con.	Abs.	Con.	Abs.	Con.	Abs.
HEARING										
H(11)	19	5	10	2	9	3	-	-	-	-
H(12)	9	15	6	6	3	9	-	-	-	-
H(21)	15	9	9	4	6	5	-	-	-	-
H(22)	6	18	4	9	2	9	-	-	-	-
H(31)	9	15	6	0	3	9	-	-	-	-
H(32)	0	24	0	12	0	12	-	-	-	-
DEAF										
D(11)	17	0	13	0	4	0	8	0	9	0
D(12)	15	2	13	0	2	2	8	0	7	2
D(21)	19	0	10	0	9	0	6	0	13	0
D(22)	18	1	9	1	9	0	5	1	13	0
D(31)[1]	14	3	9	3	5	0	9	1	5	2
D(32)	19	5	11	4	8	1	11	2	8	3

[1] Data not available on entire age group.

Table A-IV- 9 . Gelb-Goldstein Color Sorting. Number of Concrete and Abstract Performances on Experiments I, IIa, IIb, III, and IV. Hearing and Deaf Age Groups.

		I		IIa		IIb		III		IV	
	N	Con.	Abs.	Con.	Abs.	Con.	Abs.	Con.	Abs.	Con.	Abs.
H(11)	24	10	14	14	10	11	13	3	21	24	0
H(12)	24	7	17	17	7	4	20	2	22	16	8
H(21)	24	10	14	19	5	10	14	2	22	19	5
H(22)	24	2	22	18	6	4	20	0	24	14	10
H(31)	24	7	17	18	6	4	20	3	21	15	9
H(32)	24	0	24	10	14	0	24	0	24	1	23
D(11)	17	5	2	14	3	13	4	13	4	17	0
D(12)	17	7	10	15	2	10	7	7	10	17	0
D(21)	19	13	6	17	2	16	3	6	13	19	0
D(22)	19	8	11	18	1	18	1	2	17	19	0
D(31)	17[1]	6	11	15	2	9	8	6	11	17	0
D(32)	24	8	16	24	0	19	5	1	23	20	4

[1] Data not available on entire age group.

Table A-IV-10. Gelb-Goldstein Color Sorting Test, Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Hearing Age Groups by Testing Session, Means and Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL TEST							
H(1)	24	4.21	2.36	24	6.21	3.67	2.[illegible]5*
H(2)	24	4.88	2.74	24	8.38	4.33	3.37**
H(3)	24	6.38	[illegible].14	24	12.47	3.51	7.25**
EXPERIMENTS I, III							
H(1)	24	2.25	1.36	24	3.34	1.55	2.60*
H(2)	24	2.67	1.20	24	4.21	1.06	7.00**
H(3)	24	3.46	1.22	24	5.00	0.00	6.42**
EXPERIMENTS IIa, IIb, IV							
H(1)	24	1.96	1.55	24	2.88	2.58	1.48
H(2)	24	2.21	2.52	24	4.17	3.61	2.13*
H(3)	24	2.92	1.72	24	7.46	2.48	7.32**

Table A-IV-11. Gelb-Goldstein Color Sorting Test. Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Deaf Age Groups by Testing Session, Means and Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL TEST							
D(1)	17	2.18	3.21	17	3.88	2.45	1.73
D(2)	19	3.16	2.43	19	3.63	3.32	0.50
D(3)	24	3.84	2.20	24	3.79	2.36	0.08
EXPERIMENTS I, III							
D(1)	17	0.59	1.00	17	2.47	1.58	4.09**
D(2)	19	1.79	1.27	19	2.89	1.63	2.34*
D(3)	24	2.79	1.22	24	2.96	1.43	0.44
EXPERIMENTS IIa, IIb, IV							
D(1)	17	1.59	2.96	17	1.41	1.97	0.21
D(2)	19	1.37	2.45	19	0.74	2.31	0.82
D(3)	24	1.04	2.01	24	0.83	1.13	0.45

Table A-IV-12. Gelb-Goldstein Color Sorting Test. Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Hearing Age Groups by Boys and Girls, Means and Significance of Differences.

	Boys			Girls			
Group	N	$\overline{X}$	SD	N	$\overline{X}$	SD	t
TOTAL TEST							
H(11)	12	3.58	2.68	12	4.83	1.90	1.32
H(12)	12	5.66	3.47	12	6.75	3.83	0.72
H(21)	13	5.00	3.29	11	4.73	2.05	0.24
H(22)	13	8.31	4.42	11	8.45	4.30	0.03
H(31)	12	5.83	1.95	12	6.91	2.27	1.24
H(32)	12	11.75	3.65	12	13.16	3.38	0.98
EXPERIMENTS I, III							
H(11)	12	2.17	1.64	12	2.33	1.07	0.28
H(12)	12	3.17	1.64	12	3.50	1.51	0.52
H(21)	13	2.61	1.26	11	2.73	1.19	0.24
H(22)	13	4.00	1.08	11	4.45	1.03	1.02
H(31)	12	3.33	0.98	12	3.58	1.44	0.50
H(32)	12	5.00	0.00	12	5.00	0.00	0.00
EXPERIMENTS IIa, IIb, IV							
H(11)	12	1.42	1.51	12	2.50	1.45	1.80
H(12)	12	2.50	2.32	12	3.25	2.86	0.71
H(21)	13	2.38	2.90	11	2.00	2.10	0.36
H(22)	13	4.31	3.82	11	4.00	3.63	0.08
H(31)	12	2.50	1.62	12	3.33	1.77	1.20
H(32)	12	6.75	3.65	12	8.16	3.38	0.98

Table A-IV-13. Gelb-Goldstein Color Sorting Test. Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Deaf Age Groups by Boys and Girls, Means and Significance of Differences.

	Boys			Girls			
Group	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL TEST							
D(11)	13	2.61	3.55	4	0.75	0.96	1.02
D(12)	13	3.54	2.50	4	5.00	2.16	1.04
D(21)	10	2.60	2.17	9	3.78	2.68	1.06
D(22)	10	3.90	4.31	9	3.33	1.66	0.36
D(31)	15	4.54	2.39	9	2.67	1.22	2.17
D(32)	15	3.74	2.43	9	3.89	2.37	0.15
EXPERIMENTS I, III							
D(11)	13	0.62	1.04	4	0.50	1.00	0.20
D(12)	13	2.23	1.59	4	3.25	1.50	1.13
D(21)	10	1.60	1.17	9	2.00	1.41	0.68
D(22)	10	2.70	1.83	9	3.11	1.45	0.55
D(31)	15	2.93	1.28	9	2.56	1.13	0.72
D(32)	15	2.87	1.46	9	3.11	1.45	0.39
EXPERIMENTS IIa, IIb, IV							
D(11)	13	2.00	3.29	4	0.25	0.50	1.04
D(12)	13	1.31	2.17	4	1.75	1.26	0.38
D(21)	10	1.00	2.21	9	1.78	2.77	0.68
D(22)	10	1.20	3.16	9	0.22	0.44	0.92
D(31)	15	1.60	2.39	9	0.11	0.33	1.83
D(32)	15	0.87	1.24	9	0.77	0.97	0.20

Table A-IV-14. Gelb-Goldstein Color Sorting Test. Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Deaf Age Groups by Day and Resident School Enrollment, Means and Significance of Differences.

	Day School			Resident School			
	N	X	SD	N	X	SD	t
TOTAL TEST							
D(11)	8	3.00	3.96	9	1.44	2.35	1.00
D(12)	8	3.38	2.50	9	4.33	2.45	0.79
D(21)	6	2.50	1.76	13	3.46	2.70	0.79
D(22)	6	4.00	5.51	13	3.46	1.94	0.32
D(31)	13	4.15	2.76	11	3.45	1.29	0.79
D(32)	13	3.31	2.18	11	4.36	2.54	1.09
EXPERIMENTS I and III							
D(11)	8	0.63	0.92	9	0.56	1.13	0.14
D(12)	8	2.00	1.51	9	2.89	1.62	1.17
D(21)	6	2.00	1.09	13	1.69	1.38	0.48
D(22)	6	2.33	1.75	13	3.15	1.57	1.02
D(31)	13	2.54	1.45	11	3.09	0.83	1.11
D(32)	13	2.77	1.48	11	3.18	1.40	0.69
EXPERIMENTS IIa, IIb, IV							
D(11)	8	2.38	3.54	9	0.89	2.32	1.04
D(12)	8	1.38	2.72	9	1.44	1.13	0.06
D(21)	6	0.50	0.84	13	1.77	2.86	1.05
D(22)	6	1.67	4.08	13	0.31	0.63	1.15
D(31)	13	1.61	2.57	11	0.36	0.67	1.56
D(32)	13	0.54	0.88	11	1.18	1.35	1.41

Table A-IV-15. Gelb-Goldstein Color Sorting Test. Number of Abstract Responses, Experiments I and III, IIa, IIb and IV, and Total Test. Hearing, Deaf, and Deaf Versus Hearing, t Values.

HEARING

	CA	t
TOTAL TEST		
H(11)-H(21)	6-9	0.92
H(12)-H(21)	8-9	1.43
H(12)-H(22)	8-11	1.87
H(21)-H(31)	9-12	2.11*
H(22)-H(31)	11-12	1.96
H(22)-H(32)	11-14	3.59**
EXPERIMENTS I, III		
H(11)-H(21)	6-9	1.20
H(12)-H(21)	8-9	1.68
H(12)-H(22)	8-11	2.23*
H(21)-H(31)	9-12	2.26*
H(22)-H(31)	11-12	2.27*
H(22)-H(32)	11-14	3.59**
EXPERIMENTS IIa, IIb, IV		
H(11)-H(21)	6-9	0.42
H(12)-H(21)	8-9	0.92
H(12)-H(22)	8-11	1.40
H(21)-H(31)	9-12	1.15
H(22)-H(31)	11-12	1.51
H(22)-H(32)	11-14	3.62**

DEAF

	CA	t
TOTAL TEST		
D(11)-D(21)	6-9	1.04
D(12)-D(21)	8-9	0.89
D(12)-D(22)	8-11	0.26
D(21)-D(31)	9-12	0.96
D(22)-D(31)	11-12	0.25
D(22)-D(32)	11-14	0.22
EXPERIMENTS I, III		
D(11)-D(21)	6-9	3.08**
D(12)-D(21)	8-9	1.42
D(12)-D(22)	8-11	0.78
D(21)-D(31)	9-12	2.27*
D(22)-D(31)	11-12	0.19
D(22)-D(32)	11-14	0.15
EXPERIMENTS IIa, IIb, IV		
D(11)-D(21)	6-9	0.24
D(12)-D(21)	8-9	1.05
D(12)-D(22)	8-11	0.93
D(21)-D(31)	9-12	0.49
D(22)-D(31)	11-12	0.68
D(22)-D(32)	11-14	0.17

DEAF VERSUS HEARING

		Total Test	Experiments I, III	Experiments IIa, IIb, IV
	CA	t	t	t
D(11)-H(11)	6-6	2.33*	4.26**	0.52
D(11)-H(32)	6-14	9.62**	22.05**	6.91**
D(12)-H(11)	8-6	0.43	0.48	1.00
D(12)-H(12)	8-8	2.28*	1.74	1.99
D(12)-H(32)	8-14	8.68**	7.91**	8.40**
D(21)-H(11)	9-6	1.44	1.15	0.95
D(21)-H(21)	9-9	2.15*	2.38*	1.09
D(21)-H(32)	9-14	12.75**	8.23**	10.68**
D(22)-H(11)	11-6	0.67	1.39	2.07*
D(22)-H(22)	11-11	3.96**	3.22**	3.54**
D(22)-H(32)	11-14	8.42**	6.39**	9.08**
D(31)-H(11)	12-6	0.56	1.46	1.77
D(31)-H(31)	12-12	4.10**	1.91	3.48**
D(31)-H(32)	12-14	10.15**	9.21**	9.88**
D(32)-H(11)	14-6	0.62	1.78	2.90**
D(32)-H(32)	14-14	13.98**	6.80**	11.84**

Table A-V-1. Piaget Tasks. Conservation of Number. Number and Per Cent of Responses According to Stages. Hearing Boys, Girls, and Combined Sexes by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
H(11)	24	0	9	13	2	0	37.5	54.2	8.3
H(12)	24	0	1	15	8	0	4.2	62.5	33.3
H(21)	24	0	0	10	14	0	0	41.7	58.3
H(22)	24	0	0	4	20	0	0	16.7	83.3
BOYS									
H(11)	12	0	5	6	1	0	41.7	50.3	8.3
H(12)	12	0	1	8	3	0	8.3	66.7	25.0
H(21)	13	0	0	4	9	0	0	30.8	69.2
H(22)	13	0	0	1	12	0	0	7.7	92.3
GIRLS									
H(11)	12	0	4	7	1	0	33.3	58.3	8.3
H(12)	12	0	0	7	5	0	0	58.3	41.7
H(21)	11	0	0	6	5	0	0	54.6	45.5
H(22)	11	0	0	3	8	0	0	27.3	72.7

Table A-V-2. Piaget Tasks. Conservation of Number. Number and Per Cent of Responses According to Stages. Deaf Boys, Girls, Combined Sexes, and Day and Resident School Enrollment by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
D(12)	17	5	1	5	6	29.4	5.9	29.4	35.3
D(21)	19	0	8	6	5	0	42.1	31.6	26.3
D(22)	19	0	1	7	11	0	5.3	36.8	57.9
D(31)	24	0	3	8	13	0	12.5	33.3	54.2
D(32)	24	0	0	0	24	0	0	0	100.0
BOYS									
D(12)	13	4	0	4	5	30.8	0	30.8	38.5
D(21)	10	0	5	3	2	0	50.0	30.0	20.0
D(22)	10	0	1	3	6	0	10.0	30.0	60.0
D(31)	15	0	2	4	9	0	13.3	26.7	60.0
D(32)	15	0	0	0	15	0	0	0	100.0
GIRLS									
D(12)	4	1	1	1	1	25.0	25.0	25.0	25.0
D(21)	9	0	3	3	3	0	33.3	33.3	33.3
D(22)	9	0	0	4	5	0	0	44.4	55.5
D(31)	9	0	1	4	4	0	0	44.4	44.4
D(32)	9	0	0	0	9	0	0	0	100.0
DAY SCHOOL									
D(12)	8	3	0	1	4	37.5	0	12.5	50.0
D(21)	6	0	4	1	1	0	66.7	16.7	16.7
D(22)	6	0	1	1	4	0	16.7	16.7	66.7
D(31)	13	0	2	5	6	0	15.4	38.5	46.2
D(32)	13	0	0	0	13	0	0	0	100.0
RESIDENT SCHOOL									
D(12)	9	2	1	4	2	22.2	11.1	44.4	22.2
D(21)	13	0	4	5	4	0	30.8	38.5	30.8
D(22)	13	0	0	6	7	0	0	46.2	53.9
D(31)	11	0	1	3	7	0	9.9	27.3	63.6
D(32)	11	0	0	0	11	0	0	0	100.0

Table A-V-3. Piaget Tasks. Conservation of Number. Mean Quantitative Scores, Hearing and Deaf Age Groups. Significance of Differences in Selected Comparisons.

	CA	Hearing N	Hearing $\bar{X}$	Hearing SD	Deaf N	Deaf $\bar{X}$	Deaf SD
(11)	6	24	2.30	1.53	--	----	----
(12)	8	24	3.65	0.61	17	2.52	1.75
(21)	9	24	3.72	0.46	19	2.63	1.79
(22)	11	24	3.88	0.43	19	3.39	1.09
(31)	12	--	----	----	24	3.47	0.95
(32)	14	--	----	----	24	4.00	0.00

Significance of Differences

	CA	t
H(11)-H(12)	6-8	4.03**
H(21)-H(22)	9-11	1.28
H(12)-H(21)	8-9	0.43
H(11)-H(21)	6-9	4.35**
H(12)-H(22)	8-11	1.54

	CA	t
D(21)-D(22)	9-11	1.58
D(31)-D(32)	12-14	2.75**
D(12)-D(21)	8-9	0.19
D(22)-D(31)	11-12	0.36
D(12)-D(22)	8-11	1.81
D(21)-D(31)	9-12	1.97
D(22)-D(32)	11-14	2.76**

Hearing versus Deaf

	CA	t
D(32)-H(22)	14-11	1.32
D(32)-H(21)	14-9	3.23**
D(31)-H(22)	12-11	1.96
D(31)-H(11)	12-6	3.18**
D(22)-H(22)	11-11	1.93
D(22)-H(21)	11-9	1.33
D(22)-H(11)	11-6	2.63*
D(21)-H(21)	9-9	2.86**
D(21)-H(12)	9-8	2.62*
D(21)-H(11)	9-6	0.66
D(12)-H(12)	8-8	2.94**
D(12)-H(11)	8-6	0.42

Table A-V-4. Piaget Tasks. Conservation of Substance. Number and Per Cent of Responses According to Stages. Hearing Boys, Girls, and Combined Sexes by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
H(11)	24	0	14	8	2	0	58.3	33.3	8.3
H(12)	24	0	1	7	16	0	4.2	29.2	66.7
H(21)	24	0	3	3	18	0	12.5	12.5	75.0
H(22)	24	0	0	4	20	0	0	16.7	83.3
H(31)	24	0	0	4	20	0	0	16.7	83.3
H(32)	24	0	0	0	24	0	0	0	100.0
BOYS									
H(11)	12	0	6	4	2	0	50.0	33.3	16.7
H(12)	12	0	1	2	9	0	8.3	16.7	75.0
H(21)	13	0	2	2	9	0	15.4	15.4	69.2
H(22)	13	0	0	1	12	0	0	7.7	92.3
H(31)	12	0	0	2	10	0	0	16.7	83.3
H(32)	12	0	0	0	12	0	0	0	100.0
GIRLS									
H(11)	12	0	8	4	0	0	66.7	33.3	0
H(12)	12	0	0	5	7	0	0	41.7	58.3
H(21)	11	0	1	1	9	0	9.9	9.9	81.8
H(22)	11	0	0	3	8	0	0	27.3	72.7
H(31)	12	0	0	2	10	0	0	16.7	83.3
H(32)	12	0	0	0	12	0	0	0	100.0

Table A-V- 5. Piaget Tasks. Conservation of Substance. Number and Per Cent of Responses According to Stages. Deaf Boys, Girls, Combined Sexes, and Day and Resident School Enrollment by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
D(12)	17	13	2	2	0	76.5	11.8	11.8	0
D(21)	19	9	10	0	0	47.4	52.6	0	0
D(22)	19	4	11	2	2	21.1	57.9	10.5	10.5
D(31)	24	3	11	4	6	12.5	45.8	16.7	25.0
D(32)	24	0	15	3	6	0	62.5	12.5	25.0
BOYS									
D(12)	13	10	2	1	0	76.9	15.4	7.7	0
D(21)	10	6	4	0	0	60.0	40.0	0	0
D(22)	10	0	7	2	1	0	70.0	20.0	10.0
D(31)	15	2	5	4	4	13.3	33.3	26.7	26.7
D(32)	15	0	8	3	4	0	53.3	20.0	26.7
GIRLS									
D(12)	4	3	0	1	0	75.0	0	25.0	0
D(21)	9	3	6	0	0	33.3	66.7	0	0
D(22)	9	4	4	0	1	44.4	44.4	0	11.1
D(31)	9	1	6	0	2	11.1	66.7	0	22.2
D(32)	9	0	7	0	2	0	77.7	0	22.2
DAY SCHOOL									
D(12)	8	7	0	1	0	87.5	0	12.5	0
D(21)	6	5	1	0	0	83.3	16.7	0	0
D(22)	6	0	4	0	2	0	66.7	0	33.3
D(31)	13	1	6	2	4	7.7	46.2	15.4	30.8
D(32)	13	0	9	2	2	0	69.2	15.4	15.4
RESIDENT SCHOOL									
D(12)	9	6	2	1	0	66.7	22.2	11.1	0
D(21)	13	4	9	0	0	30.8	69.2	0	0
D(22)	13	4	7	2	0	30.8	53.9	15.4	0
D(31)	11	2	5	2	2	18.2	45.5	18.2	18.2
D(32)	11	0	6	1	4	0	54.6	9.9	36.4

Table A-V-6. Piaget Tasks. Conservation of Substance. Mean Quantitative Scores, Hearing and Deaf Age Groups. Significance of Differences in Selected Comparisons.

		Hearing			Deaf		
	CA	N	$\bar{X}$	SD	N	$\bar{X}$	SD
(11)	6	24	2.27	2.48	--	----	----
(12)	8	24	5.27	1.46	17	0.32	0.95
(21)	9	24	5.20	2.02	19	0.32	0.94
(22)	11	24	5.85	0.54	19	0.88	1.77
(31)	12	24	5.60	0.97	24	2.33	2.68
(32)	14	24	6.00	0.00	24	2.13	2.74

Significance of Differences

	CA	*t*
H(11)-H(12)	6-8	5.11**
H(21)-H(22)	9-11	1.52
H(31)-H(32)	12-14	2.00
H(12)-H(21)	8-9	0.15
H(22)-H(31)	11-12	1.10
H(11)-H(21)	6-9	5.39**
H(12)-H(22)	8-11	1.82
H(21)-H(31)	9-12	0.87
H(22)-H(32)	11-14	1.37

	CA	*t*
D(21)-D(22)	9-11	1.24
D(31)-D(32)	12-14	0.25
D(12)-D(21)	8-9	0.01
D(22)-D(31)	11-12	2.02
D(12)-D(22)	8-11	1.18
D(21)-D(31)	9-12	3.11**
D(22)-D(32)	11-14	1.71

Hearing versus Deaf

	CA	*t*
D(32)-H(32)	14-14	6.93**
D(32)-H(12)	14-9	4.97**
D(32)-H(11)	14-8	0.20
D(31)-H(31)	12-12	5.62**
D(31)-H(11)	12-6	0.07
D(22)-H(22)	11-11	13.18**
D(22)-H(11)	11-6	2.06*
D(21)-H(21)	9-9	9.70**
D(12)-H(12)	8-8	12.27**

Table A-V-7. Piaget Tasks. Conservation of Weight. Number and Per Cent of Responses According to Stages. Hearing Boys, Girls, and Combined Sexes by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
H(11)	24	0	20	3	1	0	83.3	12.5	4.2
H(12)	24	0	2	7	15	0	8.3	29.2	62.5
H(21)	24	0	10	6	8	0	41.7	25.0	33.3
H(22)	24	0	0	6	18	0	0	25.0	75.0
H(31)	24	0	4	6	14	0	16.7	25.0	58.3
H(32)	24	0	0	0	24	0	0	0	100.0
BOYS									
H(11)	12	0	10	2	0	0	83.3	16.7	0
H(12)	12	0	1	6	5	0	8.3	50.0	41.7
H(21)	13	0	6	2	5	0	46.2	15.4	38.5
H(22)	13	0	0	4	9	0	0	30.8	69.2
H(31)	12	0	2	2	8	0	16.7	16.7	66.7
H(32)	12	0	0	0	12	0	0	0	100.0
GIRLS									
H(11)	12	0	10	1	1	0	83.3	8.3	8.3
H(12)	12	0	1	1	10	0	8.3	8.3	83.3
H(21)	11	0	4	4	3	0	36.4	36.4	27.3
H(22)	11	0	0	2	9	0	0	18.2	81.8
H(31)	12	0	2	4	6	0	16.7	33.3	50.0
H(32)	12	0	0	0	12	0	0	0	100.0

Table A-V-8. Piaget Tasks. Conservation Weight. Number and Per Cent of Responses According to Stages. Deaf Boys, Girls, Combined Sexes, and Day and Resident School Enrollment by Age Groups.

		Number Piaget Stage				Per cent Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
D(12)	17	6	7	4	0	35.3	41.2	23.5	0
D(21)	19	1	10	8	0	5.3	52.6	42.1	0
D(22)	19	0	8	7	4	0	42.1	36.8	21.1
D(31)	24	0	4	10	10	0	16.7	41.7	41.7
D(32)	24	0	1	8	15	0	4.2	33.3	62.5
BOYS									
D(12)	13	5	5	3	0	38.5	38.5	23.1	0
D(21)	10	0	6	4	0	0	60.0	40.0	0
D(22)	10	0	4	5	1	0	40.0	50.0	10.0
D(31)	15	0	3	5	7	0	20.0	33.3	46.7
D(32)	15	0	1	3	11	0	6.7	20.0	73.3
GIRLS									
D(12)	4	1	2	1	0	25.0	50.0	25.0	0
D(21)	9	1	4	4	0	11.1	44.4	44.4	0
D(22)	9	0	4	2	3	0	44.4	22.2	33.3
D(31)	9	0	1	5	3	0	11.1	55.5	33.3
D(32)	9	0	0	5	4	0	0	55.5	44.4
DAY SCHOOL									
D(12)	8	4	2	2	0	50.0	25.0	25.0	0
D(21)	6	0	3	3	0	0	50.0	50.0	0
D(22)	6	0	3	1	2	0	50.0	16.7	33.3
D(31)	13	0	2	7	4	0	15.4	53.9	30.8
D(32)	13	0	0	5	8	0	0	38.5	61.5
RESIDENT SCHOOL									
D(12)	9	2	5	2	0	22.2	55.5	22.2	0
D(21)	13	1	7	5	0	7.7	53.9	38.5	0
D(22)	13	0	5	6	2	0	38.5	46.2	15.4
D(31)	11	0	2	3	6	0	18.2	27.3	54.6
D(32)	11	0	1	3	7	0	9.9	27.3	63.6

Table A-V-9. Conservation of Weight. Mean Quantitative Scores, Hearing and Deaf Age Groups. Significance of Differences in Selected Comparisons.

		Hearing			Deaf		
	CA	N	$\bar{X}$	SD	N	$\bar{X}$	SD
(11)	6	24	1.50	2.04	--	----	----
(12)	8	24	5.30	1.54	17	1.13	1.66
(21)	9	24	2.10	2.71	19	2.05	2.02
(22)	11	24	5.55	1.09	19	3.03	2.18
(31)	12	24	4.70	2.06	24	3.90	1.98
(32)	14	24	5.75	1.22	24	5.26	1.49

Significance of Differences

	CA	t		CA	t
H(11)-H(12)	6-8	7.28**	D(21)-D(22)	9-11	1.44
H(21)-H(22)	9-11	3.78**	D(31)-D(32)	12-14	1.98
H(31)-H(32)	12-14	2.15*	D(12)-D(21)	8-9	1.49
H(12)-H(21)	8-9	3.15**	D(22)-D(31)	11-12	1.37
H(22)-H(31)	11-12	1.78	D(12)-D(22)	8-11	2.92**
H(11)-H(21)	6-9	2.60*	D(21)-D(31)	9-12	3.01**
H(12)-H(22)	8-11	0.65	D(22)-D(32)	11-14	3.34**
H(21)-H(31)	9-12	2.02*			
H(22)-H(32)	11-14	0.60			

Hearing versus Deaf

	CA	t
D(31)-H(31)	12-12	1.37
D(31)-H(22)	12-11	3.58*
D(31)-H(21)	12-9	0.88
D(31)-H(12)	12-8	2.74**
D(31)-H(11)	12-6	4.14**
D(22)-H(22)	11-11	4.44**
D(22)-H(21)	11-9	0.35
D(22)-H(12)	11-8	4.00**
D(22)-H(11)	11-6	2.37*
D(21)-H(21)	9-9	1.67
D(21)-H(12)	9-8	5.98**
D(21)-H(11)	9-6	0.88
D(12)-H(12)	8-8	8.29**
D(12)-H(11)	8-6	0.49

Table A-V-10. Piaget Tasks. Conservation of Volume. Number and Per Cent of Responses According to Stages. Hearing Boys, Girls, and Combined Sexes by Age Groups.

	N	Number: Piaget Stage 0	I	II	III	Per cent: Piaget Stage 0	I	II	III
COMBINED SEXES									
H(11)	24	0	21	2	1	0	87.5	8.3	4.2
H(12)	24	0	1	22	3	0	4.2	91.7	12.5
H(21)	24	0	4	18	2	0	16.7	75.0	8.3
H(22)	24	0	3	17	4	0	12.5	70.8	16.7
H(31)	24	0	1	12	11	0	4.2	50.0	45.8
H(32)	24	0	0	14	10	0	0	58.3	41.7
BOYS									
H(11)	12	0	11	1	0	0	91.7	8.3	0
H(12)	12	0	1	10	1	0	8.3	83.3	8.3
H(21)	13	0	1	11	1	0	7.7	84.6	7.7
H(22)	13	0	2	9	2	0	15.4	69.2	15.4
H(31)	12	0	0	6	6	0	0	50.0	50.0
H(32)	12	0	0	5	7	0	0	41.7	58.3
GIRLS									
H(11)	12	0	10	1	1	0	83.3	8.3	8.3
H(12)	12	0	0	10	2	0	0	83.3	16.7
H(21)	11	0	3	7	1	0	27.3	63.6	9.9
H(22)	11	0	1	8	2	0	9.9	72.7	18.2
H(31)	12	0	1	6	5	0	8.3	50.0	41.7
H(32)	12	0	0	9	3	0	0	75.0	25.0

Table A-V-11. Piaget Tasks. Conservation of Volume. Number and Per Cent of Responses According to Stages. Deaf Boys, Girls, Combined Sexes, and Day and Resident School Enrollment by Age Groups.

		Number				Per cent			
		Piaget Stage				Piaget Stage			
	N	0	I	II	III	0	I	II	III
COMBINED SEXES									
D(12)	17	14	2	1	0	82.4	11.8	5.9	0
D(21)	19	9	8	2	0	47.4	42.1	10.5	0
D(22)	19	4	9	5	1	21.1	47.4	26.3	5.3
D(31)	24	1	9	9	5	4.2	37.5	37.5	20.8
D(32)	24	0	3	18	3	0	12.5	75.0	12.5
BOYS									
D(12)	13	10	2	1	0	76.9	15.4	7.7	0
D(21)	10	4	5	1	0	40.0	50.0	10.0	0
D(22)	10	1	5	4	0	10.0	50.0	40.0	0
D(31)	15	0	5	6	4	0	33.3	40.0	26.7
D(32)	15	0	2	11	2	0	13.3	73.3	13.3
GIRLS									
D(12)	4	4	0	0	0	100.0	0	0	0
D(21)	9	5	3	1	0	55.5	33.3	11.1	0
D(22)	9	3	4	1	1	33.3	44.4	11.1	11.1
D(31)	9	1	4	3	1	11.1	44.4	33.3	11.1
D(32)	9	0	1	7	1	0	11.1	77.7	11.1
DAY SCHOOL									
D(12)	8	6	1	1	0	75.0	13.0	13.0	0
D(21)	6	4	2	0	0	66.7	33.3	0	0
D(22)	6	0	4	2	0	0	66.7	33.3	0
D(31)	13	1	5	4	3	7.7	38.5	30.8	23.1
D(32)	13	0	2	9	2	0	15.4	69.2	15.4
RESIDENT SCHOOL									
D(12)	9	8	1	0	0	88.8	11.1	0	0
D(21)	13	5	6	2	0	38.5	46.2	15.4	0
D(22)	13	4	5	3	1	30.8	38.5	23.1	7.7
D(31)	11	0	4	5	2	0	36.4	45.5	18.2
D(32)	11	0	1	9	1	0	9.9	81.8	9.9

Table A-VI-1. Watts Multiple Meaning of Words Test. Hearing and Deaf Boys and Girls by Age Groups, Comparison of Means and Significance of Differences: Hearing and Deaf Age Groups by Selected Comparisons, t Values.

	Hearing (40 item test)			Deaf (Revised 15 item test)		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
BOYS						
(21)	13	15.85	5.62	-	-	-
(22)	13	18.00	7.13	9[1]	3.00	2.00
(31)	12	20.83	6.99	15	3.27	1.71
(32)	12	25.58	8.13	13[1]	4.00	2.20
GIRLS						
(21)	11	16.00	3.03	-	-	-
(22)	11	17.82	4.64	7[1]	2.57	1.98
(31)	12	23.17	4.95	9	2.67	1.73
(32)	12	26.50	3.54	9	3.22	1.48
SEXES COMBINED						
(21)	24	15.92	4.53	-	-	-
(22)	24	17.92	5.99	16[1]	2.81	1.94
(31)	24	22.00	6.04	24	3.04	1.71
(32)	24	26.04	6.15	22[1]	3.68	1.94

t Values for Selected Comparisons between Age Groups, Hearing and Deaf Subjects.

	CA	t		CA	t
SESSION COMPARISONS					
H(21)-H(22)	9-11	1.31			
H(31)-H(32)	12-14	2.29*	D(31)-D(32)	12-14	0.38
AGE COMPARISONS					
H(21)-H(31)	9-12	3.94**			
H(21)-H(32)	9-14	4.93**			
H(22)-H(31)	11-12	2.35*	D(22)-D(31)	11-12	0.31
H(22)-H(32)	11-14	4.64**	D(22)-D(32)	11-14	0.89
BOY-GIRL COMPARISONS					
H(21)-H(21)	9-9	0.08			
H(22)-H(22)	11-11	0.07	D(22)-D(22)	11-11	0.43
H(31)-H(31)	12-12	0.95	D(31)-D(31)	12-12	0.83
H(32)-H(32)	14-14	0.36	D(32)-D(32)	14-14	0.65

Table A-VI-2. Moran Word Tests: Word Definitions. Hearing Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	X	SD	N	X	SD	t
TOTAL SCORES								
H(1)	(-)	24	11.46	2.82	24	3.83	2.37	10.17**
H(1)	(½+)	24	3.88	1.98	24	7.13	3.77	3.74**
H(1)	(+)	24	9.67	2.35	24	14.04	3.71	4.86**
H(2)	(-)	24	3.00	2.30	24	2.00	1.47	1.79
H(2)	(½+)	24	6.04	2.63	24	4.67	3.55	1.52
H(2)	(+)	24	15.96	3.13	24	18.13	3.26	2.36*
H(3)	(-)	24	2.54	2.52	24	2.04	2.16	0.78
H(3)	(½+)	24	2.83	1.34	24	1.21	1.67	3.68**
H(3)	(+)	24	19.63	2.67	24	21.75	2.69	2.75**
THING ITEM SCORES								
H(1)	(-)	24	0.58	0.71	24	0.29	0.62	1.45
H(1)	(½+)	24	1.79	1.32	24	1.25	1.70	1.20
H(1)	(+)	24	7.63	1.44	24	8.46	1.67	1.84
H(2)	(-)	24	0.17	0.48	24	0.25	0.45	0.57
H(2)	(½+)	24	1.42	1.35	24	0.96	1.16	1.28
H(2)	(+)	24	8.42	1.28	24	8.79	1.14	1.06
H(3)	(-)	24	0.38	0.65	24	0.25	0.85	0.59
H(3)	(½+)	24	1.38	0.91	24	0.58	1.28	2.50*
H(3)	(+)	24	8.25	1.19	24	9.17	1.63	2.24*
NONTHING ITEM SCORES								
H(1)	(-)	24	10.83	2.50	24	3.38	2.16	11.12**
H(1)	(½+)	24	2.13	1.75	24	5.96	3.00	5.39**
H(1)	(+)	24	2.04	2.11	24	5.67	3.36	4.48**
H(2)	(-)	24	2.83	2.08	24	1.71	1.52	2.11*
H(2)	(½+)	24	4.63	1.81	24	3.71	3.18	1.23
H(2)	(+)	24	7.54	2.57	24	9.33	3.09	2.18*
H(3)	(-)	24	2.17	2.24	24	1.79	1.50	0.69
H(3)	(½+)	24	1.46	0.93	24	0.63	0.82	3.46**
H(3)	(+)	24	11.38	2.06	24	12.58	1.53	2.31*

Table A-VI-3. Moran Word Tests: Word Definitions. Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

		Boys			Girls			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	_t_
TOTAL SCORES								
H(11)	(-)	12	11.00	2.95	12	11.92	2.75	0.79
H(11)	(½+)	12	4.25	1.66	12	3.50	2.28	0.92
H(11)	(+)	12	9.75	2.30	12	9.58	2.50	0.17
H(12)	(-)	12	3.83	2.21	12	3.83	2.62	0.00
H(12)	(½+)	12	8.00	4.51	12	6.25	2.77	1.14
H(12)	(+)	12	13.17	4.09	12	14.92	3.23	1.17
H(21)	(-)	13	3.46	2.44	11	2.45	2.11	1.10
H(21)	(½+)	13	4.54	2.33	11	7.82	1.72	3.62**
H(21)	(+)	13	17.00	3.61	11	14.73	1.95	1.86
H(22)	(-)	13	2.08	1.61	11	1.91	1.37	0.28
H(22)	(½+)	13	3.69	3.25	11	5.82	3.68	1.51
H(22)	(+)	13	19.08	3.25	11	17.00	3.13	1.59
H(31)	(-)	12	3.25	2.73	12	1.83	2.17	1.41
H(31)	(½+)	12	2.92	1.51	12	2.75	1.22	0.30
H(31)	(+)	12	18.83	3.10	12	20.42	1.97	1.50
H(32)	(-)	12	2.58	2.61	12	1.50	1.51	1.24
H(32)	(½+)	12	1.75	2.14	12	0.67	0.78	1.64
H(32)	(+)	12	20.67	3.13	12	22.83	1.47	2.12*
THING ITEM SCORES								
H(11)	(-)	12	0.42	0.52	12	0.75	0.87	1.10
H(11)	(½+)	12	1.92	1.17	12	1.67	1.50	0.43
H(11)	(+)	12	7.67	1.30	12	7.58	1.62	0.08
H(12)	(-)	12	0.17	0.57	12	0.42	0.67	0.95
H(12)	(½+)	12	2.08	2.07	12	0.42	0.52	2.69*
H(12)	(+)	12	7.75	2.05	12	9.17	0.72	2.28*
H(21)	(-)	13	0.23	0.60	12	0.09	0.30	0.70
H(21)	(½+)	13	0.69	0.30	11	2.27	1.27	3.44**
H(21)	(+)	13	9.08	1.04	11	7.64	1.12	3.27**
H(22)	(-)	13	0.23	0.44	11	0.27	0.47	0.23
H(22)	(½+)	13	0.77	1.24	11	1.18	1.08	0.85
H(22)	(+)	13	9.00	1.22	11	8.55	1.03	0.96

Table A-VI-3 (continued). Moran Word Tests: Word Definitions. Hearing Age Groups by Boys and Girls, Comparison and Significance of Differences.

		Boys			Girls			
		N	$\overline{X}$	SD	N	$\overline{X}$	SD	t
THING ITEM SCORES								
H(31)	(-)	12	0.58	0.79	12	0.17	0.39	1.58
H(31)	(½+)	12	1.50	0.80	12	1.25	1.05	0.64
H(31)	(+)	12	7.92	1.24	12	8.58	1.08	1.37
H(32)	(-)	12	0.42	1.17	12	0.08	0.28	0.97
H(32)	(½+)	12	0.92	1.68	12	0.25	0.62	1.29
H(32)	(+)	12	8.67	2.10	12	9.67	0.78	1.54
NONTHING ITEM SCORES								
H(11)	(-)	12	10.50	2.81	12	11.17	2.21	0.65
H(11)	(½+)	12	2.41	1.57	12	1.83	1.95	0.80
H(11)	(+)	12	2.08	1.73	12	2.00	1.48	0.12
H(12)	(-)	12	3.33	2.27	12	3.42	2.15	0.10
H(12)	(½+)	12	6.08	3.66	12	5.83	2.33	0.53
H(12)	(+)	12	5.58	3.99	12	5.75	2.77	0.12
H(21)	(-)	13	3.23	2.05	11	2.36	2.11	0.32
H(21)	(½+)	13	3.85	1.82	11	5.55	1.37	2.54*
H(21)	(+)	13	7.92	3.09	11	7.09	1.81	0.78
H(22)	(-)	13	1.77	1.74	11	1.64	1.28	0.32
H(22)	(½+)	13	2.92	2.40	11	4.64	3.83	1.33
H(22)	(+)	13	10.08	2.75	11	8.45	3.36	1.30
H(31)	(-)	12	2.67	2.57	12	1.67	1.82	1.10
H(31)	(½+)	12	1.42	0.99	12	1.50	0.91	0.21
H(31)	(+)	12	10.92	2.47	12	11.83	1.53	1.10
H(32)	(-)	12	2.17	1.59	12	1.42	1.38	1.23
H(32)	(½+)	12	0.83	0.94	12	0.42	0.67	1.24
H(32)	(+)	12	12.00	1.54	12	13.17	1.34	1.98

Table A-VI-4. Moran Word Tests: Word Definitions. Deaf Age Groups by Testing Session, Comparison of Means and Significance of Differences.

Group	Subscore	First Session N	First Session $\bar{X}$	First Session SD	Second Session N	Second Session $\bar{X}$	Second Session SD	t
TOTAL SCORES								
D(2)	(-)	19	-	-	19	14.32	4.35	-
D(2)	(½+)	19	-	-	19	5.74	5.16	-
D(2)	(+)	19	-	-	19	4.95	3.40	-
D(3)	(-)	24	13.25	5.95	24	7.00	4.55	4.08**
D(3)	(½+)	24	4.42	3.30	24	5.00	4.59	0.50
D(3)	(+)	24	7.33	5.59	24	12.88	6.47	3.17**
THING ITEM SCORES								
D(2)	(-)	19	-	-	19	3.95	2.61	-
D(2)	(½+)	19	-	-	19	2.74	2.62	-
D(2)	(+)	19	-	-	19	3.32	2.62	-
D(3)	(-)	24	4.04	3.31	24	1.21	1.64	3.68**
D(3)	(½+)	24	1.75	1.92	24	2.08	2.26	0.54
D(3)	(+)	24	4.21	3.15	24	6.67	2.84	2.83**
NONTHING ITEM SCORES								
D(2)	(-)	19	-	-	19	10.37	1.38	-
D(2)	(½+)	19	-	-	19	3.00	1.46	-
D(2)	(+)	19	-	-	19	1.63	0.88	-
D(3)	(-)	24	8.54	3.63	24	5.79	3.54	2.67*
D(3)	(½+)	24	2.92	2.64	24	2.92	3.06	0.00
D(3)	(+)	24	3.21	3.05	24	6.21	4.44	2.73**

Table A-VI-5. Moran Word Tests: Word Definitions. Deaf Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

Group	Subscore	Boys N	Boys $\bar{X}$	Boys SD	Girls N	Girls $\bar{X}$	Girls SD	*t*
TOTAL SCORES								
D(22)	(-)	10	15.10	3.93	9	13.40	4.85	0.82
D(22)	(½+)	10	4.80	4.24	9	6.78	5.74	0.95
D(22)	(+)	10	5.10	2.85	9	4.78	4.29	0.19
D(31)	(-)	15	12.47	6.94	9	14.56	3.81	0.83
D(31)	(½+)	15	4.27	3.63	9	4.67	2.60	0.28
D(31)	(+)	15	8.27	6.35	9	5.78	3.86	1.06
D(32)	(-)	15	7.00	5.03	9	7.00	3.81	0.00
D(32)	(½+)	15	5.13	3.78	9	4.78	5.95	0.18
D(32)	(+)	15	12.67	6.42	9	13.22	6.82	0.20
THING ITEM SCORES								
D(22)	(-)	10	4.40	1.90	9	3.44	3.28	0.79
D(22)	(½+)	10	2.10	1.85	9	3.44	3.24	1.12
D(22)	(+)	10	3.50	2.01	9	3.11	3.29	0.31
D(31)	(-)	15	3.07	3.33	9	5.67	0.28	1.91
D(31)	(½+)	15	2.40	2.13	9	0.67	0.22	2.34*
D(31)	(+)	15	4.53	3.36	9	3.67	2.87	0.64
D(32)	(-)	15	1.07	1.53	9	1.44	1.88	0.53
D(32)	(½+)	15	1.80	1.70	9	2.56	3.05	0.89
D(32)	(+)	15	7.07	2.37	9	6.00	3.54	1.19
NONTHING ITEM SCORES								
D(22)	(-)	10	10.70	3.65	9	10.00	2.06	0.51
D(22)	(½+)	10	2.70	3.47	9	3.33	0.89	0.43
D(22)	(+)	10	1.60	2.12	9	1.67	1.66	0.08
D(31)	(-)	15	8.27	4.04	9	9.00	2.96	0.47
D(31)	(½+)	15	2.53	2.70	9	3.56	2.55	0.93
D(31)	(+)	15	3.67	3.33	9	2.44	2.51	0.95
D(32)	(-)	15	5.93	4.03	9	5.56	2.74	0.24
D(32)	(½+)	15	3.33	2.69	9	2.22	3.67	0.87
D(32)	(+)	15	5.60	4.53	9	7.22	4.44	0.86

Table A-VI-6 . Moran Word Tests: Word Definitions. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

		Day School			Resident School			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(22)	(-)	6	2.00	1.91	13	7.46	5.32	2.41*
D(22)	(½+)	6	7.00	3.58	13	4.77	3.79	1.21
D(22)	(+)	6	9.00	3.22	13	11.46	4.68	1.16
D(31)	(-)	13	15.00	5.89	11	11.18	5.58	1.62
D(31)	(½+)	13	3.69	2.29	11	5.27	4.15	1.18
D(31)	(+)	13	6.31	5.86	11	8.55	5.26	0.98
D(32)	(-)	13	6.62	4.33	11	7.45	4.97	0.44
D(32)	(½+)	13	6.54	4.86	11	3.18	3.66	1.88
D(32)	(+)	13	11.69	6.86	11	14.27	5.98	0.97
THING ITEM SCORES								
D(22)	(-)	6	3.50	1.87	13	4.15	2.94	0.49
D(22)	(½+)	6	.67	.82	13	3.69	2.63	3.90**
D(22)	(+)	6	5.83	2.23	13	2.15	1.91	3.72**
D(31)	(-)	13	4.77	3.35	11	3.18	3.43	1.15
D(31)	(½+)	13	1.23	1.30	11	2.36	2.38	1.47
D(31)	(+)	13	4.00	3.46	11	4.45	2.88	0.34
D(32)	(-)	13	.85	1.41	11	1.64	1.86	1.26
D(32)	(½+)	13	2.92	2.69	11	1.09	1.04	2.12*
D(32)	(+)	13	6.23	3.03	11	7.18	2.64	0.81
NONTHING ITEM SCORES								
D(22)	(-)	6	12.50	1.64	13	9.38	2.93	2.41*
D(22)	(½+)	6	1.33	1.37	13	3.77	3.42	0.82
D(22)	(+)	6	1.17	1.47	13	1.85	2.03	0.36
D(31)	(-)	13	9.62	3.38	11	6.91	2.91	2.08*
D(31)	(½+)	13	3.00	2.08	11	3.27	3.10	0.25
D(31)	(+)	13	2.38	3.15	11	4.09	2.88	1.38
D(32)	(-)	13	5.77	3.27	11	5.82	4.00	0.03
D(32)	(½+)	13	3.62	2.90	11	2.09	3.18	1.23
D(32)	(+)	13	5.46	4.33	11	7.09	4.68	0.89

Table A-VI-7. Moran Word Tests: Word Definitions. Hearing and Deaf Age Groups by Selected Comparisons, t Values.

Subscores	Scores: Total	Scores: Thing	Scores: Non-thing	Scores: Total	Scores: Thing	Scores: Non-thing
HEARING GROUPS:	H(11)-H(21):CA 6-9			H(12)-H(21):CA 8-9		
(-)	11.43**	2.41*	12.12**	1.22	0.71	0.89
(½+)	3.22**	0.95	4.81**	1.16	1.27	1.87
(+)	7.86**	2.03*	8.09**	1.94	0.10	2.15*
HEARING GROUPS:	H(12)-H(22):CA 8-11			H(21)-H(31):CA 9-12		
(-)	3.21**	0.29	3.09**	0.66	1.24	1.06
(½+)	2.32**	0.64	2.53*	5.35**	0.12	7.73**
(+)	4.05**	0.81	3.94**	4.37**	0.47	5.73**
HEARING GROUPS:	H(22)-H(31):CA 11-12			H(22)-H(32):CA 11-14		
(-)	0.90	0.76	0.84	0.08	0.00	0.18
(½+)	2.39*	1.40	3.31**	4.33*	1.09	4.62**
(+)	1.74	1.64	2.58*	4.16**	0.93	4.58**
DEAF GROUPS:	D(22)-D(31):CA 11-12			D(22)-D(32):CA 11-14		
(-)	0.66	0.09	1.78	5.34**	4.22**	4.53**
(½+)	1.02	1.43	0.09	0.50	0.88	0.08
(+)	1.62	1.29	1.98	4.81**	3.17*	4.20**
DEAF AND HEARING GROUPS:	D(22)-H(11):CA 11-6			D(22)-H(12):CA 11-8		
(-)	2.61*	6.02**	0.55	10.09**	6.65**	8.96**
(½+)	1.63	1.53	1.16	1.02	2.26*	3.15**
(+)	5.30**	6.84**	0.66	8.19**	7.79**	4.70**
DEAF AND HEARING GROUPS:	D(22)-H(21):CA 11-9			D(22)-H(22):CA11-11		
(-)	10.99**	7.00**	9.79**	12.97**	6.85**	12.55**
(½+)	0.25	2.13*	2.17*	0.80	2.97**	0.73
(+)	9.10**	8.36**	8.44**	12.79**	9.27**	9.51**

Table A-VI-7 (continued). Moran Word Tests: Word Definitions. Hearing and Deaf Age Groups by Selected Comparisons, *t* Values.

Subscores	Scores: Total	Scores: Thing	Scores: Non-thing	Scores: Total	Scores: Thing	Scores: Non-thing
DEAF AND HEARING GROUPS:	D(31)-H(11):CA 12-6			D(31)-H(12):CA 12-8		
(-)	1.32	4.87	2.54*	7.19**	5.28**	6.00**
(½+)	0.68	0.08	1.22	2.66*	0.96	3.75**
(+)	1.89	4.87**	1.56	4.90**	5.90**	2.65*
DEAF AND HEARING GROUPS:	D(31)-H(21):CA 12-9			D(31)-H(32):CA 12-11		
(-)	7.88**	5.53**	6.72**	9.00**	5.41**	8.54**
(½+)	1.88	0.69	2.59*	2.52*	1.72	0.94
(+)	6.59**	6.10**	5.35**	8.00**	6.64**	6.88**
DEAF AND HEARING GROUPS:	D(31)-H(31):CA 12-12			D(32)-H(11):CA 14-6		
(-)	8.11**	5.15**	7.32**	4.07**	1.75	5.73
(½+)	2.18*	0.84	2.56*	1.10	0.54	1.10
(+)	9.76**	5.86**	10.89**	2.29*	1.48	4.13**
DEAF AND HEARING GROUPS:	D(32)-H(12):CA 14-8			D(32)-H(21):CA 14-9		
(-)	3.02**	2.56*	2.84**	3.85*	2.97**	3.52**
(½+)	1.76	1.46	3.45**	0.96	1.22	2.34*
(+)	0.76	2.67*	0.47	2.10*	2.78**	1.27
DEAF AND HEARING GROUPS:	D(32)-H(22):CA 14-11			D(32)-H(31):CA 14-12		
(-)	5.15**	2.74**	5.16**	4.21**	2.31*	4.26**
(½+)	0.28	2.15*	0.88	2.24*	1.40	2.21*
(+)	3.55**	3.42**	2.81**	4.72**	2.55*	5.17**
DEAF AND HEARING GROUPS:	D(32)-H(32):CA 14-14					
(-)	4.82**	2.59*	5.06**			
(½+)	3.83**	2.83**	3.52**			
(+)	6.20**	3.73**	6.64**			

Table A-VI-8 . Moran Word Tests: Synonym Recall. Hearing Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	$\overline{X}$	SD	N	$\overline{X}$	SD	*t*
TOTAL SCORES								
H(1)	N Responses	24	12.67	9.98	24	38.21	14.77	7.02**
H(1)	N Synonyms	24	1.00	1.45	24	4.83	2.94	11.27**
H(1)	% Synonyms	24	6.58	9.17	24	15.75	13.86	2.71*
H(2)	N Responses	24	36.71	13.60	24	23.54	8.11	4.04**
H(2)	N Synonyms	24	10.50	5.70	24	10.42	4.42	0.05
H(2)	% Synonyms	24	30.71	15.74	24	43.13	25.19	2.05*
H(3)	N Responses	24	41.38	16.97	24	31.25	7.94	2.64*
H(3)	N Synonyms	24	15.83	6.43	24	21.04	7.32	2.62*
H(3)	% Synonyms	24	40.08	16.17	24	67.29	14.21	6.19**
THING ITEM SCORES								
H(1)	N Responses	24	8.67	6.18	24	20.21	8.74	5.29**
H(1)	N Synonyms	24	0.50	0.88	24	2.58	1.44	5.94**
H(1)	% Synonyms	24	4.67	10.05	24	17.71	19.02	2.97**
H(2)	N Responses	24	18.04	7.75	24	10.79	3.81	4.10**
H(2)	N Synonyms	24	3.08	2.06	24	5.13	2.80	2.89**
H(2)	% Synonyms	24	21.62	16.65	24	43.13	25.19	3.49**
H(3)	N Responses	24	20.21	7.76	24	13.92	4.26	3.48**
H(3)	N Synonyms	24	4.79	2.96	24	8.83	3.41	4.30**
H(3)	% Synonyms	24	27.42	18.77	24	64.00	16.99	7.08**
NONTHING ITEM SCORES								
H(1)	N Responses	24	4.13	4.64	24	18.00	7.67	7.58**
H(1)	N Synonyms	24	0.54	1.10	24	2.25	1.80	3.89**
H(1)	% Synonyms	24	5.42	1.01	24	14.75	13.41	3.40**
H(2)	N Responses	24	18.67	8.34	24	12.75	5.07	2.97**
H(2)	N Synonyms	24	7.42	4.31	24	5.38	2.53	2.00
H(2)	% Synonyms	24	42.79	21.96	24	43.00	22.81	0.03
H(3)	N Responses	24	22.00	9.64	24	17.33	4.61	2.13*
H(3)	N Synonyms	24	11.04	4.72	24	12.21	4.53	0.87
H(3)	% Synonyms	24	53.04	19.28	24	70.04	15.34	3.38**

Table A-VI-9 Moran Word Tests: Synonym Recall. Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences

		Boys			Girls			
Group	Sub-score	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORE								
H(11)	N Responses	12	12.25	9.41	12	13.08	10.92	0.20
H(11)	N Synonyms	12	0.83	1.70	12	1.17	1.19	0.78
H(12)	N Responses	12	40.25	11.46	12	36.17	17.77	0.66
H(12)	N Synonyms	12	3.42	2.74	12	6.25	2.49	2.64*
H(21)	N Responses	13	35.85	12.10	11	37.73	15.80	0.33
H(21)	N Synonyms	13	12.15	6.40	11	8.55	4.03	1.59
H(22)	N Responses	13	24.46	3.17	11	22.45	9.44	0.72
H(22)	N Synonyms	13	11.62	5.04	11	9.00	3.42	1.45
H(31)	N Responses	12	40.42	18.90	12	42.33	15.50	0.27
H(31)	N Synonyms	12	14.67	5.11	12	17.00	7.41	0.88
H(32)	N Responses	12	27.17	6.90	12	35.33	0.82	2.89**
H(32)	N Synonyms	12	17.67	5.26	12	24.42	7.72	2.50
THING ITEM SCORES								
H(11)	N Responses	12	9.00	6.82	12	8.33	5.63	0.28
H(11)	N Synonyms	12	0.25	0.45	12	0.75	1.14	1.44
H(12)	N Responses	12	22.08	8.84	12	18.33	8.61	1.06
H(12)	N Synonyms	12	1.75	1.05	12	3.42	1.31	3.41
H(21)	N Responses	13	17.62	6.78	11	18.55	9.08	0.30
H(21)	N Synonyms	13	3.77	2.46	11	2.27	1.10	1.88
H(22)	N Responses	13	11.31	4.11	11	10.18	3.63	0.70
H(22)	N Synonyms	13	6.00	3.34	11	4.09	1.58	1.74
H(31)	N Responses	12	20.75	8.97	12	19.67	6.69	0.34
H(31)	N Synonyms	12	4.33	1.56	12	5.25	3.83	0.75
H(32)	N Responses	12	12.33	3.26	12	15.50	4.68	1.92
H(32)	N Synonyms	12	7.67	2.42	12	10.00	4.01	1.69

Table A-VI-9 (continued). Moran Word Tests: Synonym Recall. Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

Group	Sub-score	Boys N	Boys $\bar{X}$	Boys SD	Girls N	Girls $\bar{X}$	Girls SD	t
NONMTHING ITEM SCORES								
H(11)	N Responses	12	3.50	3.68	12	4.75	5.53	0.65
H(11)	N Synonyms	12	0.67	1.44	12	0.42	0.67	0.54
H(12)	N Responses	12	18.17	4.65	12	17.83	10.06	0.11
H(12)	N Synonyms	12	1.67	1.88	12	2.83	1.59	1.63
H(21)	N Responses	13	18.23	8.52	11	19.18	8.41	0.27
H(21)	N Synonyms	13	8.38	4.87	11	6.27	3.31	1.20
H(22)	N Responses	13	13.15	4.02	11	12.27	6.18	0.42
H(22)	N Synonyms	13	5.62	2.14	11	4.91	3.33	0.63
H(31)	N Responses	12	20.92	9.39	12	23.08	10.16	0.54
H(31)	N Synonyms	12	10.33	5.09	12	11.75	4.65	0.71
H(32)	N Responses	12	14.83	4.00	12	19.83	4.01	3.01**
H(32)	N Synonyms	12	10.00	3.28	12	14.42	4.64	2.70*

Table A-VI-10. Moran Word Tests: Synonym Recall. Deaf Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(2)	N Responses	19	-	-	19	16.95	6.65	-
D(2)	N Synonyms	19	-	-	19	1.53	1.07	-
D(2)	% Synonyms	19	-	-	19	10.74	10.13	-
D(3)	N Responses	24	20.75	9.88	24	27.92	11.60	2.30*
D(3)	N Synonyms	24	5.46	4.31	24	9.08	5.02	2.68*
D(3)	% Synonyms	24	24.38	17.34	24	33.04	15.64	1.82
THING ITEM SCORES								
D(2)	N Responses	19	-	-	19	8.68	2.11	-
D(2)	N Synonyms	19	-	-	19	1.16	0.96	-
D(2)	% Synonyms	19	-	-	19	14.53	12.79	-
D(3)	N Responses	24	10.75	4.77	24	14.50	6.50	2.27*
D(3)	N Synonyms	24	2.29	2.40	24	4.83	2.50	3.58**
D(3)	% Synonyms	24	18.75	13.79	24	35.67	16.76	3.63**
NONTHING ITEM SCORES								
D(2)	N Responses	19	-	-	19	8.26	4.87	-
D(2)	N Synonyms	19	-	-	19	0.37	0.50	-
D(2)	% Synonyms	19	-	-	19	7.89	2.25	-
D(3)	N Responses	24	9.92	5.79	24	13.42	6.65	1.94
D(3)	N Synonyms	24	3.50	2.34	24	4.21	3.43	0.84
D(3)	% Synonyms	24	32.63	2.70	24	32.08	24.77	0.11

Table A-VI- 11. Moran Word Tests: Synonym Recall. Deaf Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

		Boys			Girls			
Group	Sub-score	N	$\overline{X}$	SD	N	$\overline{X}$	SD	t
TOTAL SCORES								
D(22)	N Responses	10	17.90	8.72	9	15.89	3.41	0.65
D(22)	N Synonyms	10	1.40	0.96	9	1.67	1.21	0.54
D(31)	N Responses	15	22.20	11.70	9	18.33	5.54	0.93
D(31)	N Synonyms	15	6.13	4.95	9	4.33	2.87	0.99
D(32)	N Responses	15	26.13	11.10	9	30.89	12.50	0.96
D(32)	N Synonyms	15	9.60	5.13	9	8.22	9.45	0.47
THING ITEM SCORES								
D(22)	N Responses	10	8.70	2.79	9	8.67	1.12	0.03
D(22)	N Synonyms	10	0.90	0.88	9	1.44	1.01	1.23
D(31)	N Responses	15	11.40	5.58	9	9.67	2.94	0.86
D(31)	N Synonyms	15	2.60	2.92	9	1.78	1.09	0.80
D(32)	N Responses	15	13.53	6.37	9	16.11	6.77	0.94
D(32)	N Synonyms	15	4.93	2.25	9	4.67	3.00	0.25
NONTHING ITEM SCORES								
D(22)	N Responses	10	9.20	6.29	9	7.22	2.59	0.88
D(22)	N Synonyms	10	0.50	0.53	9	0.22	0.44	1.27
D(31)	N Responses	15	10.80	6.68	9	8.44	3.81	0.97
D(31)	N Synonyms	15	3.47	2.56	9	3.56	2.07	0.09
D(32)	N Responses	15	12.60	6.84	9	14.78	6.48	0.77
D(32)	N Synonyms	15	4.67	3.62	9	3.44	2.92	0.16

Table A-VI-12. Moran Word Tests: Synonym Recall. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

		Day School			Resident School			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(22)	N Response	6	13.67	6.77	13	18.46	6.28	1.51
D(22)	N Synonyms	6	2.17	.75	13	1.23	1.09	1.90
D(22)	% Synonyms	6	19.67	12.50	13	6.62	5.53	3.22**
D(31)	N Response	13	16.92	9.42	11	25.18	8.73	2.21*
D(31)	N Synonyms	13	5.23	3.90	11	5.82	4.96	0.33
D(31)	% Synonyms	13	26.38	20.19	11	22.00	13.81	0.61
D(32)	N Response	13	28.15	11.04	11	27.64	12.91	0.10
D(32)	N Synonyms	13	9.31	4.87	11	8.82	5.42	0.23
D(32)	% Synonyms	13	34.23	16.81	11	31.64	14.81	0.40
THING ITEM SCORES								
D(22)	N Response	6	7.33	2.34	13	9.31	1.75	2.73*
D(22)	N Synonyms	6	1.83	.98	13	.85	.80	2.31*
D(22)	% Synonyms	6	25.67	13.35	13	9.38	8.96	3.16**
D(31)	N Response	13	9.15	4.45	11	12.36	4.86	1.69
D(31)	N Synonyms	13	1.62	1.45	11	3.18	3.16	1.60
D(31)	% Synonyms	13	15.38	13.30	11	22.73	13.90	1.32
D(32)	N Response	13	14.62	5.41	11	14.36	7.88	0.09
D(32)	N Synonyms	13	4.92	1.85	11	4.73	3.20	0.18
D(32)	% Synonyms	13	36.23	14.53	11	35.00	19.79	0.17
NONTHING ITEM SCORES								
D(22)	N Response	6	6.33	5.05	13	9.15	4.72	1.18
D(22)	N Synonyms	6	.33	.52	13	.38	.51	0.20
D(22)	% Synonyms	6	17.67	39.94	13	3.38	4.94	1.31
D(31)	N Response	13	7.08	5.94	11	12.73	5.22	2.45*
D(31)	N Synonyms	13	4.31	2.78	11	2.73	2.05	1.56
D(31)	% Synonyms	13	39.62	31.29	11	24.36	18.96	1.41
D(32)	N Response	13	13.54	6.96	11	13.27	6.60	0.10
D(32)	N Synonyms	13	7.23	10.86	11	4.09	3.05	0.93
D(32)	% Synonyms	13	33.92	28.16	11	29.91	21.23	0.39

Table A-VI-13. Moran Word Tests: Synonym Recall. Hearing and Deaf Subjects by Selected Age Group Comparisons, t Values.

	Scores: Total	Scores: Thing	Scores: Nonthing	Scores: Total	Scores: Thing	Scores: Nonthing
HEARING GROUPS:	H(11)-H(21):CA 6-9			H(12)-H(21):CA 8-9		
N Response	7.15**	4.64**	7.46**	0.37	0.91	0.29
N Synonym	7.92**	5.61**	7.56**	4.33**	0.98	5.44**
HEARING GROUPS:	H(12)-H(22):CA 8-11			H(21)-H(31):CA 9-12		
N Response	4.38**	4.83**	3.59**	1.05	0.97	1.28
N Synonym	5.08**	3.98**	4.94**	3.05**	2.34*	2.74**
HEARING GROUPS:	H(22)-H(31):CA 11-12			H(22)-H(32):CA 11-14		
N Response	4.63**	5.32**	4.17**	3.31**	2.65*	3.25**
N Synonym	3.38**	0.41	5.15**	6.03**	4.02**	6.44**
DEAF GROUPS:	D(22)-D(31):CA 11-12			D(22)-D(32):CA 11-14		
N Response	1.43	1.75	1.00	3.64**	3.73**	2.84**
N Synonym	3.89**	1.92	5.69**	6.45**	6.02**	4.86**
DEAF AND HEARING GROUPS:	D(22)-H(11):CA 11-6			D(22)-H(12):CA 11-8		
N Response	1.61	0.01	2.83**	5.81**	5.60**	4.82**
N Synonym	1.34	2.36*	0.65	4.62**	3.64**	4.48**
DEAF AND HEARING GROUPS:	D(22)-H(21):CA 11-9			D(22)-H(22):CA 11-11		
N Response	5.95*	5.11**	4.82**	2.84**	2.13*	2.93**
N Synonym	6.74*	3.76**	7.12**	8.39**	5.93**	8.49**
% Synonym				5.26**	4.50**	5.04**
DEAF AND HEARING GROUPS:	D(31)-H(11):CA 12-6			D(31)-H(12):CA 12-8		
N Response	2.82**	1.31	3.83**	4.81**	4.66**	4.12**
N Synonym	4.81**	3.41**	5.58**	0.59	0.51	2.08*
% Synonym						

Table A-VI-13 (continued). Moran Word Tests: Synonym Recall. Hearing and Deaf Subjects by Selected Age Group Comparisons, *t* Values.

	Scores			Scores		
	Total	Thing	Nonthing	Total	Thing	Nonthing
DEAF AND HEARING GROUPS:	D(31)-H(21):CA 12-9			D(31)-H(22):CA 12-11		
N Response	4.76**	3.92**	4.23**	1.22	0.32	1.80
N Synonym	3.45**	1.22	3.92**	3.88**	3.79**	2.65*
DEAF AND HEARING GROUPS:	D(31)-H(31):CA 12-12			D(32)-H(11):CA 14-6		
N Response	9.87**	5.09**	5.28**	4.87**	3.19**	5.60**
N Synonym	6.56**	3.21**	6.92**	7.55**	8.02**	5.03**
% Synonym	6.69**	1.82	3.02**			
DEAF AND HEARING GROUPS:	D(32)-H(12):CA 14-8			D(32)-H(21):CA 14-9		
N Response	2.68*	2.57*	2.21*	2.39*	1.72	2.41**
N Synonym	3.57**	3.81**	2.48*	0.92	2.65*	2.87**
DEAF AND HEARING GROUPS:	D(32)-H(22):CA 14-11			D(32)-H(31):CA 14-12		
N Response	1.51	2.39*	0.39	3.20**	2.76**	3.59**
N Synonym	0.97	0.39	1.34	4.07**	0.05	5.64**
DEAF AND HEARING GROUPS:	D(32)-H(32):CA 14-14					
N Response	1.16	0.36	2.36*			
N Synonym	6.61**	4.55**	6.90**			
% Synonym	7.94**	5.81**	6.38**			

SUMMARY

Title: A STUDY OF COGNITIVE DEVELOPMENT AND PERFORMANCE OF CHILDREN WITH NORMAL AND DEFECTIVE HEARING

Investigator: Mildred C. Templin

Institution: University of Minnesota

Project Number: 387

Duration: April 1, 1958 to December 31, 1963

BACKGROUND

This study was an attempt to increase and refine the understanding of cognitive development and performance in deaf and hearing children. Since the area investigated is central to the learning of academic subject matter, the relevance of the study for improving the learning environment of both hearing and deaf children is self evident. However, the potential value of the study was enhanced because the same subjects were retested after an interval of two years; because a number of cognitive areas were investigated; because characteristics of performance on some tests were examined; and because the sample spanned the elementary and junior high school years. Since the study focused upon an area in which the deaf have been found to be inferior and attempted to delineate characteristics of the variability in their performance, it has special value for current evaluation, rethinking and research in the field of the education of the deaf.

OBJECTIVES

1. To determine the longitudinal changes that occur over a two-year period in the performance of the same hearing and deaf subjects on selected cognitive tasks, and to compare the changes that are found for the deaf and the hearing.

2. To determine in cross-sectional comparisons with the hearing the extent and the variability of the inferiority of the deaf on cognitive tasks selected to measure several areas of cognition with testing techniques using language and nonlanguage responses.

3. To delineate some specific characteristics of the performance of deaf and hearing subjects on selected cognitive tasks.

PROCEDURE

The study was a modified longitudinal design in which subjects were given a substantial number of tests at two testing sessions separated by a period of two years. The sample was distributed into three age categories made up of hearing and deaf subjects on whom test data were essentially complete for both testing sessions.

The hearing and deaf samples were of comparable age, socioeconomic status and intelligence. At the first testing session the subjects were approximately 6, 9 and 12 years of age; at the second testing session they were approximately 8, 11 and 14. Intelligence of both deaf and hearing in each age category was within the normal range on the WISC Performance Scale and the Harris Revision of the Goodenough Draw-a-Man Test. The hearing sample included 72 children, 24 in each age group. They were selected from regular public school classes and had no known handicapping conditions. Of the 60 deaf subjects, 24 were in the oldest, 19 in the middle, and 17 in the youngest age groups. For the several age groups, the mean hearing loss over the speech range in the ear with the most hearing was between 86 and 91 decibels. All deaf subjects selected for study were enrolled in special classes for the hearing impaired in one residential and two day schools. They were deaf from birth or before the age of two, and had no other known handicapping conditions.

Measures were selected to assess the performance of subjects (1) in

different areas of cognition; (2) by language and nonlanguage techniques; (3) on information acquired incidentally or provided in the testing situation, and (4) with measures that, insofar as possible, were suitable for administration to both hearing and deaf children ranging in age over the elementary and junior high school years.

The three tests requiring nonlanguage responses were (1) The Raven Progressive Matrices Test: Colored sets A, A_B, B are referred to as Part I, black and white sets C, D, E are referred to as Part II, and all six sets are referred to as the Total test. (2) The Weigl-Goldstein-Scheerer Color Form Sorting Test in which the subject was first to sort 12 figures (three different forms of four colors each) on the category of his choice, and then to shift the category of sorting from color to form, or vice versa. (3) The Gelb-Goldstein Color Sorting Test in which the subject sorted skeins of yarn to a sample or a named color (Experiments I and III); and in which the subject was first to match yarns on hue or brightness and then to shift the dimension of matching (Experiments IIa, IIb and IV). In addition to the classification of performance as Abstract or Concrete, quantitative scores were determined for the types of experiments and for the test as a whole.

Four conservation tasks were taken from the work of Piaget and his associates: Conservation of Number, Substance, Weight, and Volume. The essential aspects of testing on these tasks were a demonstration, a prediction elicited from the subject, a demonstrated verification, and an explanation of the prediction and/or verification for each transformation. An effort was made to systematize testing procedures by using the same materials and providing pretest and test experiences as similar as possible for all subjects. As much systematization of the materials and procedures was introduced for each task as could be done without inter-

fering with Piaget's clinical method. Test sessions were tape recorded, and for the most part, both an observer and an examiner participated in the testing situation.

Performances were classified into Piaget stages. For the conservation of number, substance and weight it was possible to predetermine transformations to be used and the order of their presentation to the subjects. These were used to determine quantitative scores based on the rationale that each transformation could be considered a test item.

Seven vocabulary measures assessed understanding and use of common words. A test of the knowledge of multiple meanings of words presented eight common words in a multiple-choice format, to be used with five different meanings to complete sentences. Since the test was originally constructed by Watts for use with English children it was necessary to modify the sentences so that all words were used in contexts that were meaningful to American children. Since the modified test was too difficult for use with the deaf subjects, a test appropriate for them was constructed using five words in 15 sentences selected on the basis of performance of 9- and 12-year-old hearing subjects. Six vocabulary tests previously devised by Moran for use with normal and schizophrenic adults used the same 25 common words in tests of Definitions, Synonym Recall, Synonym Recognition, Sentence Construction, Similarities, and Analogies. Ten of the words were thing referent, and 15 were nonthing referent.

The specific tests administered in the study were developed and used by other investigators. When it was necessary they were modified to be more appropriate for use with the present hearing and deaf samples. Special attention was given to developing techniques and to training examiners for work with the deaf to ensure the most adequate testing possible. The tests were given to hearing and deaf subjects at both testing

session and to as many of the age groups as possible. With only a few exceptions, all tests were administered to each hearing age group at both testing sessions. For the deaf this was not true since many of the tests were too difficult for the younger subjects. All deaf age groups at both testing sessions were given the tests requiring nonlanguage responses; the youngest age deaf group at the first session (CA 6) was not given the conservation tasks; and the youngest age deaf group at both sessions (CA 6 and CA 8) and the middle age deaf group at the first session (CA 9) were not given the vocabulary tests.

A number of analyses were quite systematically carried out for the separate measures, and the specific characteristics of performance of some were examined and described. The systematic analyses were: longitudinal changes for the hearing and deaf samples; cross sectional age comparisons within and between hearing and deaf samples; sex comparisons for both samples at all age levels tested; and resident and day school comparisons for the deaf at all age levels tested. Frequently no statistical tests were applied to the data presented. For calculations on measures yielding quantitative scores, Student's t test was used; for calculations on measures yielding qualitative scores McNemar's Test for Significance of Changes, and Fisher's Exact Probability Test were most frequently used. The .01 level of confidence was taken as statistically significant.

RESULTS

1. On practically all tests, older hearing subjects obtained better scores than younger, although the range of achievement, and the highest level attained varied among the tests. No age trends were apparent when very few responses occurred in a scoring category, e.g. the Number of Neologisms identified on the Synonym Recognition Test. Some scores first

increased and then decreased over the age range tested when they represented an intermediate level of success (e.g. partially correct definitions), or reflected a developmental trend related to the task (e.g. Number of responses on the Synonym Recall Test). For the most part, the deaf tended to follow the same trends over the age range tested, but, with the exception of the Progressive Matrices Test, the Conservation of Number and the Color Form Sorting tests, performance of the CA 14 deaf was considerably below the maximum performance of the hearing. The Color Sorting, Conservation of Substance, Conservation of Volume and Analogies tests were too difficult for the oldest deaf age group..

2. With a few specific exceptions, the scores of the deaf were below those of the hearing at the same age. The extent of the inferiority of their performance varied among the tests and the age groups. The performance of the deaf and hearing was similar throughout the age range on the Progressive Matrices Test, and at the older ages on the Conservation of Number, and the Color Form Sorting tests. The inferiority of their performance is greatest throughout the age range tested on the vocabulary measures, and at the older ages tested on the Color Sorting Test and the Conservation of Substance.

2.1. On the Progressive Matrices Test the performance of the deaf and hearing was relatively high, and the scores were similar except at CA 9. On Part I (sets A, A_B, B) the differences in mean scores were not significant except at CA 9 on the six age levels compared, and the actual mean scores were most similar to those of the hearing at the same ages in four. On Part II (sets C, D, E) and the Total the scores of the deaf resembled those of the hearing just slightly below the deaf age level considered, and the differences between scores at the same ages (except CA 9) were not statistically significant.

2.2. On the Color Form Sorting Test only the scores at Ca 11 differed significantly. On this test both deaf and hearing shifted from essentially Concrete to essentially Abstract performance during the age range studied. The shift to Abstract performance occurred later for the deaf than for the hearing, and this was reflected in the one significant difference found.

2.3. On the Color Sorting Test both classification and quantitative scores for the test as a whole, tended to be significantly different at CA 11, CA 12 and CA 14, and not significantly different at the younger ages. The scores of the deaf showed relatively little change over the age range tested, and at all ages the deaf most resembled the hearing at or below CA 6. The hearing on the other hand obtained substantially better scores at the older ages.

2.4. The sequence of understanding of conservation for the deaf was number, weight, substance, volume. The order of substance and weight varied from that of the established sequence. The performance of the deaf on the Conservation of Number task increased throughout the age range tested, and did not differ significantly from that of the hearing by CA 11. On the Conservation of Substance task the performance of the deaf at each age tested was significantly below that of the hearing at the same age, and at all ages it was below that of the CA 6 hearing. The hearing and the deaf did not differ in understanding of the conservation of weight at CA 6, CA 9, and CA 12 (i.e. at the first testing session), but did at CA 8, CA 11, and CA 14 (i.e. at the second testing session). The Conservation of Volume task was too difficult for the younger hearing and for the deaf at all ages.

2.5. On the tests of knowledge and use of common words, the deaf were extremely inferior to the hearing. For the most part the CA 14

deaf resembled the hearing six to eight years younger.

3. Three comparisons of longitudinal change in the performance of the same subjects were possible for the hearing--between CA 6-8, CA 9-11, and CA 12-14. For the deaf the number of longitudinal comparisons varied: the three comparisons were possible on tests classified as needing non-language responses; those for the middle and oldest age groups on the conservation tasks; and one for the oldest age group for the vocabulary measures. With the restriction that the data did not permit evaluations on all tests for all ages, the longitudinal analyses suggested:

3.1. Deaf children tended to show less significant increases in cognitive performance from the first to the second testing sessions than hearing children.

3.2. Patterns of longitudinal change in scores on the several tests between the first and second testing sessions differed for the hearing and the deaf regardless of the level of achievement of the deaf.

3.3. Changes in the performance of the deaf tended to occur at older ages and to resemble those of considerably younger hearing children on the several tests.

3.4. On a number of tests the oldest deaf achieved at a low level and showed no substantial improvement in performance between CA 12-14 (e.g. Multiple Meanings of Words, Analogies, Experiments IIa, IIb and IV on Color Sorting Test and the Conservation of Number).

4. Throughout the study no essential differences were found in the performance of boys and girls in the same age groups. This held for both hearing and deaf samples.

5. The performance of day and resident school deaf subjects at the same age level did not differ on the tests. The similarity in performance was not merely the result of the small number of subjects in the age sub-

groups, since resident and day school subjects each obtained about half the better scores, and the mean scores at each age level were very similar. Only on the Progressive Matrices and the Analogies tests did the day school subjects quite consistently obtain the better scores, but at a nonsignificant level.

6. Teachers of hearing children perceived their students at the older ages as more curious and less dependent in solving problems in which either language or manipulation of materials were major components. Teachers of deaf children tended to perceive their students as less curious and more dependent in such tasks at the older ages.

7. Characteristics of performance of the deaf on some tests were delineated as follows:

7.1. On the Color Form Sorting Test, the tendency of the deaf to shift categories of sorting resembled that of the hearing when they initially sorted on form, but not when they initially sorted on color or mixed categories.

7.2. The deaf tended to respond to verbal analogy problems with an association to a specific word in the problem rather than to the relationship that is basic in analogy.

7.3. Performance of the deaf in the construction of sentences tended to become more inferior to that of the hearing when the number of words to be incorporated in the sentences was increased.

7.4. From age group to age group the deaf were less stable than the hearing in their knowledge of multiple meanings of words.

7.5. Examination of the protocols of the Piaget tasks illustrated that a concept might be understood before the precise word(s) for it was part of the subject's vocabulary.

7.6. The deaf tended to perseverate in their responses on a

number of tests.

7.7. In comparisons between age groups separated by one year (CA 8-9 and CA 11-12) the younger age group was at its second and the older age group at its first testing session. Although differences in mean scores in almost all comparisons for both deaf and hearing were not significant, the younger deaf age group obtained the better scores much less frequently than did the younger hearing age group.

7.8. In the sequence of the understanding of conservation, the order of weight and substance was reversed by the deaf from the established sequence for hearing subjects.

CONCLUSIONS

1. On test-retest after two years the deaf subjects tended to show less significant increments than did the hearing; comparable increments for the deaf tended to occur for considerably older age groups than for the hearing.

2. Although the deaf were inferior to the hearing at the same age on most of the cognitive measures, they were similar throughout the age range on the Progressive Matrices Test and at the older ages tested on the Color From Sorting Test and on the Conservation of Number Task.

3. The deaf children, when compared to the hearing children, varied considerably in the level of their performance on different tests. On the basis of the present study the differences found cannot be exclusively attributed to the necessity for language or nonlanguage responses, information used in the tests as presented in a controlled testing situation or as acquired through everyday experience, nor to the particular cognitive area tested.

4. The known language deficit of the deaf was reemphasized. It was, however, also shown to exist in thier knowledge and use of very common

words. Nevertheless, at the oldest age studied, the deaf were not inferior to the hearing on all tests that employed language responses.

5. The known difficulty of the deaf in dealing with abstract problems was reemphasized and some provocative characteristics of related performance on some tests delineated.

6. Findings suggested that further consideration should be given to environmental factors as they relate to the cognitive performance of the deaf: e.g. the effect of the testing situation on the sequence of understanding of conservation of number, weight, substance, volume by the deaf; the lack of difference in performance of the resident and day school subjects; teacher perception of curiosity and dependency in their students; the possible effect of previous testing and/or incidental learning on test performance.

7. The use of the quantitative scores that were devised for those tests on which classification of behavior is accepted should be further explored with a different sample if their worth is to be determined.

8. There is need for intensive study of language, cognition and learning of deaf children. It is only through systematic, concentrated and continued investigation of specific functions that the behavior of the deaf will be better understood.

BIBLIOGRAPHY

There 116 references listed in the final report.

Table A-VI-14. Moran Word Tests: Synonym Recognition. Hearing Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
H(1)	Synonyms	24	23.17	9.81	24	20.25	7.91	1.13
H(1)	Nonsynonyms	24	36.33	12.20	24	43.88	9.62	2.37*
H(1)	Neologisms	24	2.13	1.73	24	0.79	1.06	3.27**
H(1)	% Synonyms	24	37.67	8.41	24	30.37	6.92	3.28**
H(1)	% Neologisms	24	3.38	2.00	24	1.04	1.33	4.77**
H(2)	Synonyms	24	33.96	4.78	24	31.83	10.55	0.90
H(2)	Nonsynonyms	24	39.83	16.40	24	31.38	21.10	1.54
H(2)	Neologisms	24	1.79	1.56	24	1.13	1.60	1.43
H(2)	% Synonyms	24	45.86	7.37	24	54.00	17.47	2.10
H(2)	% Neologisms	24	2.21	1.79	24	1.46	1.93	1.40
H(3)	Synonyms	24	38.04	9.46	24	37.79	13.10	0.08
H(3)	Nonsynonyms	24	23.46	16.27	24	17.38	12.80	1.47
H(3)	Neologisms	24	1.13	1.08	24	0.54	0.66	2.27
H(3)	% Synonyms	24	64.21	15.30	24	70.58	17.87	1.33
H(3)	% Neologisms	24	1.67	1.52	24	0.96	1.20	1.80
THING ITEM SCORES								
H(1)	Synonyms	24	6.96	3.43	24	9.50	3.16	2.62
H(1)	Nonsynonyms	24	18.63	6.75	24	22.83	4.98	2.46
H(1)	Neologisms	24	1.04	0.91	24	0.50	0.72	2.25
H(1)	% Synonyms	24	26.17	7.65	24	28.67	6.82	1.19
H(1)	% Neologisms	24	3.42	2.80	24	1.29	1.88	3.09**
H(2)	Synonyms	24	14.13	2.80	24	14.71	4.69	0.36
H(2)	Nonsynonyms	24	17.96	9.31	24	13.75	9.54	1.54
H(2)	Neologisms	24	0.88	0.74	24	0.58	0.83	1.36
H(2)	% Synonyms	24	46.58	12.94	24	55.88	19.87	1.92
H(2)	% Neologisms	24	2.50	2.40	24	1.67	2.35	1.21
H(3)	Synonyms	24	15.96	3.68	24	17.17	5.69	0.88
H(3)	Nonsynonyms	24	11.67	6.54	24	9.00	7.25	1.70
H(3)	Neologisms	24	0.79	0.77	24	0.42	0.50	1.85
H(3)	% Synonyms	24	58.56	13.29	24	70.06	18.11	2.51*
H(3)	% Neologisms	24	2.21	2.02	24	1.50	1.89	1.26

Table A-VI-14 (continued). Moran Word Tests: Synonym Recognition. Hearing Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	X	SD	N	X	SD	t
NONTHING ITEM SCORES								
H(1)	Synonyms	24	16.25	7.00	24	10.75	5.38	3.06**
H(1)	Nonsynonyms	24	17.71	6.86	24	21.04	6.50	1.73
H(1)	Neologisms	24	1.08	1.12	24	0.29	0.55	2.98**
H(1)	% Synonyms	24	46.04	8.73	24	32.58	8.60	5.38**
H(1)	% Neologisms	24	2.46	2.38	24	0.75	1.39	3.04**
H(2)	Synonyms	24	19.83	2.91	24	16.71	6.74	2.08*
H(2)	Nonsynonyms	24	22.71	7.31	24	17.63	12.10	1.75
H(2)	Neologisms	24	0.92	1.17	24	0.54	1.18	1.10
H(2)	% Synonyms	24	46.96	6.80	24	52.23	16.04	1.48
H(2)	% Neologisms	24	1.92	2.39	24	1.13	2.35	1.15
H(3)	Synonyms	24	22.08	6.43	24	20.63	8.00	0.69
H(3)	Nonsynonyms	24	11.79	10.23	24	9.63	7.64	0.83
H(3)	Neologisms	24	0.29	0.62	24	0.13	0.45	1.14
H(3)	% Synonyms	24	69.50	18.63	24	70.63	19.16	0.21
H(3)	% Neologisms	24	0.63	1.28	24	0.33	1.27	0.82

Table A-VI-15. Moran Word Tests: Synonym Recognition Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	*t*
TOTAL SCORES							
H(11) Synonyms	12	26.42	10.54	12	19.92	8.45	1.67
H(11) Nonsynonyms	12	36.67	10.31	12	36.00	14.30	0.13
H(11) Neologisms	12	2.58	1.68	12	1.67	1.72	1.31
H(12) Synonyms	12	19.92	8.23	12	20.58	7.94	0.20
H(12) Nonsynonyms	12	39.42	6.22	12	48.33	10.55	2.52*
H(12) Neologisms	12	0.67	0.98	12	0.92	1.16	0.57
H(21) Synonyms	13	34.00	4.00	11	33.91	5.77	0.04
H(21) Nonsynonyms	13	39.31	15.50	11	40.45	18.10	0.16
H(21) Neologisms	13	1.38	0.87	11	2.27	2.05	1.44
H(22) Synonyms	13	30.15	6.44	11	33.82	14.00	0.84
H(22) Nonsynonyms	13	29.00	15.50	11	34.18	26.90	0.59
H(22) Neologisms	13	0.69	1.55	11	1.64	1.56	1.48
H(31) Synonyms	12	38.08	10.64	12	38.00	8.58	0.02
H(31) Nonsynonyms	12	25.58	19.70	12	21.33	12.40	0.63
H(31) Neologisms	12	1.25	1.05	12	1.00	1.13	0.56
H(32) Synonyms	12	35.17	12.70	12	40.42	13.60	0.97
H(32) Nonsynonyms	12	19.50	15.10	12	15.25	10.10	0.82
H(32) Neologisms	12	0.58	0.67	12	0.50	0.67	0.29
THING ITEM SCORES							
H(11) Synonyms	12	7.83	3.33	12	6.08	3.55	0.18
H(11) Nonsynonyms	12	18.42	5.30	12	18.83	8.19	0.18
H(11) Neologisms	12	1.17	0.84	12	0.92	0.99	0.67
H(12) Synonyms	12	9.42	3.00	12	9.58	3.45	0.12
H(12) Nonsynonyms	12	21.08	4.36	12	24.58	5.12	1.80
H(12) Neologisms	12	0.42	0.80	12	0.58	0.67	0.53
H(21) Synonyms	13	14.54	2.85	11	13.64	2.80	0.78
H(21) Nonsynonyms	13	17.46	9.18	11	18.55	10.08	0.28
H(21) Neologisms	13	0.69	0.48	11	1.09	0.94	1.33

Table A-VI-15 (continued). Moran Word Tests: Synonym Recognition Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

		Boys			Girls			
Group	Sub-score	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
THING ITEM SCORES								
H(22)	Synonyms	13	14.62	4.07	11	14.82	5.55	0.10
H(22)	Nonsynonyms	13	13.69	8.15	11	13.82	11.30	0.03
H(22)	Neologisms	13	0.38	0.77	11	0.82	0.42	1.32
H(31)	Synonyms	12	15.58	3.85	12	16.33	3.63	0.49
H(31)	Nonsynonyms	12	13.00	8.47	12	10.33	3.60	0.10
H(31)	Neologisms	12	0.83	0.84	12	0.75	0.75	0.24
H(32)	Synonyms	12	16.08	5.53	12	18.25	5.88	0.93
H(32)	Nonsynonyms	12	9.83	3.34	12	8.17	6.23	0.55
H(32)	Neologisms	12	0.42	0.51	12	0.42	0.52	0.00
NONTHING ITEM SCORES								
H(11)	Synonyms	12	18.67	7.33	12	13.83	6.00	1.77
H(11)	Nonsynonyms	12	18.25	5.97	12	17.17	7.88	0.38
H(11)	Neologisms	12	1.42	1.17	12	0.75	1.05	1.46
H(12)	Synonyms	12	10.50	5.96	12	11.00	4.99	0.22
H(12)	Nonsynonyms	12	18.33	5.47	12	23.75	6.51	2.21*
H(12)	Neologisms	12	0.25	0.45	12	0.33	0.65	0.36
H(21)	Synonyms	13	19.46	1.98	11	20.27	3.90	0.67
H(21)	Nonsynonyms	13	22.62	6.53	11	22.82	8.58	0.06
H(21)	Neologisms	13	0.69	0.85	11	1.18	1.47	1.02
H(22)	Synonyms	13	14.77	3.42	11	19.00	8.89	1.58
H(22)	Nonsynonyms	13	15.31	8.06	11	20.36	15.70	1.01
H(22)	Neologisms	13	0.31	0.85	11	0.82	1.47	1.06
H(31)	Synonyms	12	22.50	7.49	12	21.67	5.47	0.31
H(31)	Nonsynonyms	12	12.58	11.63	12	11.00	9.07	0.37
H(31)	Neologisms	12	0.42	0.79	12	0.17	0.39	0.96
H(32)	Synonyms	12	19.08	7.41	12	22.17	8.40	0.94
H(32)	Nonsynonyms	12	9.67	7.69	12	9.58	7.92	0.03
H(32)	Neologisms	12	0.17	0.57	12	0.08	0.28	0.53

Table A-VI-16. Moran Word Tests: Synonym Recognition. Deaf Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	X̄	SD	N	X̄	SD	t
TOTAL SCORES								
D(2)	Synonyms	19	-	-	19	15.11	11.50	-
D(2)	Nonsynonyms	19	-	-	19	30.58	14.20	-
D(2)	Neologisms	19	-	-	19	1.89	2.35	-
D(2)	% Synonyms	19	-	-	19	33.11	8.16	-
D(2)	% Neologisms	19	-	-	19	3.79	3.34	-
D(3)	Synonyms	24	14.04	5.62	24	17.21	10.10	1.45
D(3)	Nonsynonyms	24	25.29	11.04	24	46.96	26.30	3.72**
D(3)	Neologisms	24	0.92	0.83	24	1.54	1.89	1.48
D(3)	% Synonyms	24	34.25	10.19	24	33.38	11.36	0.28
D(3)	% Neologisms	24	2.29	1.92	24	2.58	2.76	0.42
THING ITEM SCORES								
D(2)	Synonyms	19	-	-	19	6.21	7.09	-
D(2)	Nonsynonyms	19	-	-	19	15.63	8.13	-
D(2)	Neologisms	19	-	-	19	0.89	1.29	-
D(2)	% Synonyms	19	-	-	19	26.10	10.26	-
D(2)	% Neologisms	19	-	-	19	3.42	4.29	-
D(3)	Synonyms	24	6.88	3.78	24	7.92	4.46	0.87
D(3)	Nonsynonyms	24	13.42	6.28	24	23.79	11.40	3.88**
D(3)	Neologisms	24	0.58	0.66	24	0.79	1.02	0.80
D(3)	% Synonyms	24	31.50	13.88	24	30.56	11.38	0.26
D(3)	% Neologisms	24	2.67	2.78	24	2.88	3.65	0.33
NONTHING ITEM SCORES								
D(2)	Synonyms	19	-	-	19	8.89	6.35	-
D(2)	Nonsynonyms	19	-	-	19	14.95	7.76	-
D(2)	Neologisms	19	-	-	19	1.00	1.37	-
D(2)	% Synonyms	19	-	-	19	39.50	11.05	-
D(2)	% Neologisms	19	-	-	19	3.47	4.21	-
D(3)	Synonyms	24	7.79	4.98	24	9.58	6.06	1.12
D(3)	Nonsynonyms	24	10.92	6.48	24	22.63	16.34	3.26**
D(3)	Neologisms	24	0.25	0.53	24	1.54	2.73	2.26*
D(3)	% Synonyms	24	36.85	8.69	24	38.77	13.27	0.21
D(3)	% Neologisms	24	1.25	2.66	24	1.75	2.64	1.30

Table A-VI-17. Moran Word Tests: Synonym Recognition. Deaf Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

		Boys			Girls			
Group	Sub-score	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(22)	Synonyms	10	15.50	12.39	9	14.67	11.36	0.13
D(22)	Nonsynonyms	10	31.90	15.37	9	29.11	13.56	0.42
D(22)	Neologisms	10	2.20	2.74	9	1.56	1.94	0.58
D(31)	Synonyms	15	14.47	6.47	9	12.22	6.98	0.80
D(31)	Nonsynonyms	15	27.60	11.30	9	21.44	9.96	1.34
D(31)	Neologisms	15	0.93	0.96	9	0.89	0.60	0.11
D(32)	Synonyms	15	19.20	10.75	9	13.89	8.49	1.26
D(32)	Nonsynonyms	15	49.20	27.70	9	43.22	24.70	0.53
D(32)	Neologisms	15	1.88	1.99	9	1.00	1.66	1.11
THING ITEM SCORES								
D(22)	Synonyms	10	5.50	4.48	9	7.00	9.45	0.45
D(22)	Nonsynonyms	10	15.00	7.16	9	16.33	9.49	0.35
D(22)	Neologisms	10	0.80	1.32	9	1.00	1.32	0.33
D(31)	Synonyms	15	6.27	3.99	9	7.89	3.37	1.02
D(31)	Nonsynonyms	15	14.60	6.38	9	11.44	5.94	1.21
D(31)	Neologisms	15	0.67	0.72	9	0.44	0.53	0.82
D(32)	Synonyms	15	8.60	4.42	9	6.78	4.55	0.97
D(32)	Nonsynonyms	15	24.47	11.40	9	22.67	12.10	0.36
D(32)	Neologisms	15	0.87	1.13	9	0.67	0.87	0.46
NONTHING ITEM SCORES								
D(22)	Synonyms	10	10.00	8.10	9	7.67	3.61	0.79
D(22)	Nonsynonyms	10	16.90	9.65	9	12.78	4.55	1.20
D(22)	Neologisms	10	1.40	1.71	9	0.56	0.73	1.39
D(31)	Synonyms	15	9.53	5.22	9	4.89	2.57	2.44
D(31)	Nonsynonyms	15	13.00	6.56	9	7.44	4.88	2.20
D(31)	Neologisms	15	0.27	0.59	9	0.22	0.44	0.23
D(32)	Synonyms	15	10.93	6.75	9	7.33	4.12	1.44
D(32)	Nonsynonyms	15	24.20	17.90	9	20.00	13.70	0.60
D(32)	Neologisms	15	1.67	2.64	9	1.33	3.04	0.29

Table A-VI-18. Moran Word Tests: Synonym Recognition. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

		Day School			Resident School			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(22)	Synonyms	6	11.67	6.47	13	16.69	13.24	0.87
D(22)	Nonsynonyms	6	35.17	15.12	13	28.46	13.86	0.95
D(22)	Neologisms	6	1.50	1.38	13	2.08	2.72	0.49
D(31)	Synonyms	13	13.23	6.52	11	14.09	6.99	0.31
D(31)	Nonsynonyms	13	24.31	10.17	11	25.91	12.69	0.34
D(31)	Neologisms	13	1.00	.82	11	.82	.87	0.52
D(32)	Synonyms	13	18.69	11.60	11	15.45	8.21	0.78
D(32)	Nonsynonyms	13	48.38	29.18	11	37.09	13.77	1.17
D(32)	Neologisms	13	1.92	2.06	11	1.09	1.64	1.08
THING ITEM SCORES								
D(22)	Synonyms	6	3.83	2.23	13	7.31	8.32	0.99
D(22)	Nonsynonyms	6	17.17	6.11	13	14.92	9.05	0.55
D(22)	Neologisms	6	.33	.52	13	1.15	1.46	1.32
D(31)	Synonyms	13	6.15	3.29	11	6.91	4.25	0.49
D(31)	Nonsynonyms	13	13.15	5.08	11	14.55	7.29	0.72
D(31)	Neologisms	13	.54	.66	11	.73	.65	0.71
D(32)	Synonyms	13	8.85	5.08	11	6.82	3.52	1.12
D(32)	Nonsynonyms	13	28.23	13.04	11	18.55	6.55	2.23*
D(32)	Neologisms	13	1.00	.82	11	.55	1.21	1.08
NONTHING ITEM SCORES								
D(22)	Synonyms	6	7.83	4.54	13	9.38	7.15	0.48
D(22)	Nonsynonyms	6	18.00	11.21	13	13.54	5.59	1.18
D(22)	Neologisms	6	1.17	1.47	13	.92	1.38	0.36
D(31)	Synonyms	13	6.46	3.71	11	7.18	4.69	0.42
D(31)	Nonsynonyms	13	11.08	5.72	11	11.36	6.93	0.11
D(31)	Neologisms	13	.38	.65	11	.09	.30	1.36
D(32)	Synonyms	13	10.00	6.87	11	9.09	5.24	0.36
D(32)	Nonsynonyms	13	26.69	19.98	11	17.82	9.37	1.35
D(32)	Neologisms	13	1.62	2.66	11	1.45	2.94	0.14

Table A-VI-19. Moran Word Tests: Synonym Recognition. Hearing and Deaf Subjects by Selected Age Group Comparisons, t Values.

	Scores			Scores		
	Total Score	Thing Score	Nonthing Score	Total Score	Thing Score	Nonthing Score
HEARING GROUPS:	H(11)-H(21):CA 6-9			H(12)-H(21):CA 8-9		
Synonyms	4.82**	7.79**	2.32*	7.25**	5.38**	0.49
Nonsynonyms	0.84	0.28	2.43*	1.04	2.24*	0.83
Neologisms	0.71	0.67	0.48	2.56*	1.90	2.38*
HEARING GROUPS:	H(12)-H(22):CA 8-11			H(21)-H(31):CA 9-12		
Synonyms	4.30**	4.49**	3.39**	1.89	1.95	1.56
Nonsynonyms	2.63*	4.13**	1.21	3.54**	2.69**	4.23**
Neologisms	0.87	0.36	0.94	1.69	0.41	2.38*
HEARING GROUPS:	H(22)-H(31):CA 11-12			H(22)-H(32):CA 11-14		
Synonyms	2.15*	1.02	2.83**	1.78	1.99	1.84
Nonsynonyms	1.45	0.88	0.57	2.77**	1.94	2.73**
Neologisms	0.00	0.09	0.93	1.68	0.80	1.55
DEAF GROUPS:	D(22)-D(31):CA 11-12			D(22)-D(32):CA 11-14		
Synonyms	0.40	0.40	0.64	0.63	0.87	0.36
Nonsynonyms	1.37	1.01	1.86	2.44*	2.63*	1.91
Neologisms	1.90	1.03	2.50*	0.54	0.88	0.78
DEAF AND HEARING GROUPS:	D(22)-H(11):CA 11-6			D(22)-H(12):CA 11-8		
Synonyms	2.46*	0.45	3.57**	1.72	2.03*	1.04
Nonsynonyms	1.42	1.32	1.24	3.65**	3.58**	2.81
Neologisms	0.39	0.45	0.21	2.04*	1.22	2.37*
DEAF AND HEARING GROUPS:	D(22)-H(21):CA 11-9			D(22)-H(22):CA 11-11		
Synonyms	7.25**	5.01**	7.49**	4.95**	4.72**	3.87**
Nonsynonyms	1.94	0.86	3.34**	0.14	0.68	0.86
Neologisms	0.17	0.03	0.21	1.27	0.94	1.18

Table A-VI-19 (continued). Moran Word Tests: Synonym Recognition. Hearing and Deaf Subjects by Selected Age Group Comparisons, t Values.

	Scores			Scores		
	Total Score	Thing Score	Nonthing Score	Total Score	Thing Score	Nonthing Score
DEAF AND HEARING GROUPS:	D(31)-H(11):CA 12-6			D(31)-H(12):CA 12-8		
Synonyms	3.92**	0.08	4.83**	3.14**	2.61*	1.98
Nonsynonyms	3.28**	2.77**	3.54**	6.22**	5.74**	5.41**
Neologisms	3.10**	2.09*	3.46**	0.46	0.40	0.29
DEAF AND HEARING GROUPS:	D(31)-H(21):CA 12-9			D(31)-H(22):CA 12-11		
Synonyms	13.21**	7.55**	10.20**	7.29**	6.37**	5.22**
Nonsynonyms	3.60**	1.97	5.87**	1.25	0.14	2.38*
Neologisms	2.42*	1.50	2.79**	0.57	0.00	1.21
DEAF AND HEARING GROUPS:	D(31)-H(31):CA 12-12			D(32)-H(11):CA 14-6		
Synonyms	10.71**	6.09**	8.61**	2.06*	0.83	3.53**
Nonsynonyms	0.46	0.95	0.35	1.79	1.90	1.36
Neologisms	0.74	1.05	0.24	1.13	0.89	0.75
DEAF AND HEARING GROUPS:	D(32)-H(12):CA 14-8			D(32)-H(21):CA 14-9		
Synonyms	1.16	1.41	0.70	7.35**	6.18**	7.48**
Nonsynonyms	0.54	0.38	0.44	1.13	1.92	0.02
Neologisms	1.70	1.12	2.19*	0.50	0.35	1.02
DEAF AND HEARING GROUPS:	D(32)-H(22):CA 14-11			D(32)-H(31):CA 14-12		
Synonyms	4.91**	5.14**	3.85**	7.37**	6.81**	6.94**
Nonsynonyms	2.26*	3.29**	1.20	3.78**	4.50**	2.83**
Neologisms	0.82	0.81	1.61	0.93	0.00	2.19*
DEAF AND HEARING GROUPS:	D(32)-H(32):CA 14-14					
Synonyms	6.07**	6.25**	5.39**			
Nonsynonyms	4.95**	5.34**	3.53**			
Neologisms	2.44*	1.68	2.47*			

Table A-VI-20. Moran Word Tests: Sentence Construction. Hearing and Deaf Age Groups by Testing Session, Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
H(1)	24	1.42	1.53	24	4.75	2.64	5.37**
H(2)	24	7.50	2.26	24	8.04	2.94	0.72
H(3)	24	9.25	1.94	24	10.50	1.56	2.45*
D(2)	19	-	-	19	1.89	1.66	-
D(3)	24	4.50	2.76	24	5.29	2.76	1.00

Table A-VI-21. Moran Word Tests: Sentence Construction. Hearing and Deaf Age Groups by Boys and Girls, Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
H(11)	12	1.67	1.67	12	1.17	1.40	0.79
H(12)	12	3.83	2.79	12	5.67	2.19	1.75
H(21)	13	7.20	2.03	11	7.91	2.55	0.76
H(22)	13	8.15	2.94	11	7.91	3.08	0.20
H(31)	12	8.50	1.98	12	10.00	1.65	2.03
H(32)	12	9.92	1.83	12	11.08	0.99	1.93
D(22)	10	1.90	1.66	9	1.89	1.76	0.02
D(31)	15	4.73	2.84	9	4.11	2.76	0.53
D(32)	15	5.27	3.15	9	5.33	2.12	0.50

Table A-VI-22. Moran Word Tests: Sentence Construction. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

	Day School			Resident School			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
D(22)	6	2.67	1.86	13	1.54	1.51	1.41
D(31)	13	4.23	3.16	11	4.82	2.32	.51
D(32)	13	6.00	2.97	11	4.45	2.34	1.40

Table A-VI-23. Moran Word Tests: Sentence Construction. Hearing, Deaf, and Hearing Versus Deaf by Age Groups, t Values.

	CA	t Value
HEARING GROUPS:		
H(12)-H(21)	8-9	3.87**
H(22)-H(31)	11-12	1.68
H(11)-H(21)	6-9	10.86**
H(12)-H(22)	8-11	4.06**
H(21)-H(31)	9-12	2.87**
H(22)-H(32)	11-14	3.62**
DEAF GROUPS:		
D(22)-D(31)	11-12	3.62**
D(22)-H(32)	11-14	4.72**

	CA	t Value
DEAF AND HEARING GROUPS:		
D(22)-H(22)	11-11	8.20**
D(31)-H(31)	12-12	6.88**
D(32)-H(32)	14-14	8.02**
D(22)-H(11)	11-6	0.98
D(22)-H(12)	11-8	4.14**
D(22)-H(21)	11-9	9.05**
D(31)-H(11)	12-6	4.81**
D(31)-H(12)	12-8	0.32
D(31)-H(21)	12-9	4.11**
D(31)-H(22)	12-11	4.32**
D(32)-H(11)	14-6	6.05**
D(32)-H(12)	14-8	0.70
D(32)-H(21)	14-9	3.03**
D(32)-H(22)	14-11	3.35**
D(32)-H(31)	14-12	5.74**

Table A-VI-24. Moran Word Tests: Similarities. Hearing Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
H(1)	(-)	24	-	-	24	10.92	2.52	
H(1)	Abstract	24	-	-	24	1.71	1.37	
H(1)	Adequate	24	-	-	24	4.38	2.04	
H(2)	(-)	24	9.96	2.74	24	8.29	3.18	1.94
H(2)	Abstract	24	0.96	1.04	24	4.33	2.66	5.81**
H(2)	Adequate	24	6.08	2.47	24	4.38	2.32	2.46*
H(3)	(-)	24	6.88	3.08	24	5.58	2.73	1.55
H(3)	Abstract	24	3.17	2.20	24	7.63	3.37	5.44**
H(3)	Adequate	24	6.96	2.36	24	3.75	1.62	5.53**
THING ITEM SCORES								
H(1)	(-)	24	5.71	1.33	24	2.58	1.77	6.93**
H(1)	Abstract	24	-	-	24	0.67	0.87	-
H(1)	Adequate	24	1.25	1.36	24	3.75	1.57	5.90**
H(2)	(-)	24	2.33	1.75	24	1.75	1.48	1.23
H(2)	Abstract	24	0.29	0.75	24	1.88	1.51	2.74**
H(2)	Adequate	24	4.46	1.64	24	3.38	1.44	2.40*
H(3)	(-)	24	1.25	1.22	24	0.96	1.20	0.83
H(3)	Abstract	24	1.42	1.17	24	3.50	1.86	4.62**
H(3)	Adequate	24	4.33	1.34	24	2.54	1.35	4.59**
NONTHING ITEM SCORES								
H(1)	(-)[1]	24	-	-	24	8.08	1.44	-
H(1)	Abstract[1]	24	-	-	24	1.17	1.00	-
H(1)	Adequate[1]	24	-	-	24	0.75	1.03	-
H(2)	(-)	24	7.63	1.38	24	6.54	2.19	2.06*
H(2)	Abstract	24	0.75	0.61	24	2.46	1.59	4.32**
H(2)	Adequate	24	1.63	1.31	24	1.00	1.50	1.54
H(3)	(-)	24	5.63	2.06	24	4.63	1.95	1.72
H(3)	Abstract	24	1.75	1.57	24	4.13	1.87	4.76**
H(3)	Adequate	24	2.63	1.64	24	1.21	0.93	3.67**

Table A-VI-25. Moran Word Tests: Similarities. Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

		Boys			Girls			
		N	X̄	SD	N	X̄	SD	t
TOTAL SCORES								
H(11)		12	-	-	12	-	-	-
H(12)	(-)	12	11.67	2.90	12	10.17	1.90	1.50
H(12)	Abstract	12	1.92	1.68	12	1.50	1.00	0.74
H(12)	Adequate	12	3.42	1.68	12	5.33	1.97	2.55*
H(21)	(-)	13	10.15	3.26	11	9.73	2.10	0.37
H(21)	Abstract	13	1.08	1.38	11	0.82	0.40	0.59
H(21)	Adequate	13	5.77	2.68	11	6.45	2.25	0.67
H(22)	(-)	13	8.77	2.68	11	7.73	3.74	0.79
H(22)	Abstract	13	4.54	3.13	11	4.09	1.92	0.41
H(22)	Adequate	13	3.69	1.55	11	5.18	2.86	1.63
H(31)	(-)	12	8.17	3.29	12	5.58	2.32	2.23*
H(31)	Abstract	12	2.75	2.67	12	3.58	1.62	0.92
H(31)	Adequate	12	6.08	2.43	12	7.83	2.04	1.90
H(32)	(-)	12	6.83	2.79	12	4.33	2.10	2.48*
H(32)	Abstract	12	6.33	3.17	12	8.92	3.17	1.99
H(32)	Adequate	12	3.75	1.54	12	3.75	1.76	0.00
THING ITEM SCORES								
H(11)	(-)	12	6.33	0.65	12	5.08	1.56	3.34**
H(11)	Adequate	12	0.58	0.67	12	1.92	1.56	3.00**
H(12)	(-)	12	2.75	2.26	12	2.42	1.17	0.45
H(12)	Abstract	12	0.92	0.99	12	0.42	0.67	1.44
H(12)	Adequate	12	3.33	1.77	12	4.17	1.27	1.33
H(21)	(-)	13	2.77	2.09	11	1.82	1.17	1.34
H(21)	Abstract	13	0.46	0.97	11	0.09	0.30	1.23
H(21)	Adequate	13	3.92	1.85	11	5.09	1.14	1.83
H(22)	(-)	13	1.77	1.48	11	1.73	1.36	0.06
H(22)	Abstract	13	2.23	1.74	11	1.45	1.13	1.28
H(22)	Adequate	13	3.00	1.41	11	3.82	1.40	1.43

Table A-VI-25 (continued). Moran Word Tests: Similarities. Hearing Age Groups by Boys and Girls, Comparison of Means and Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
THING ITEM SCORES							
H(31) (-)	12	1.75	1.36	12	0.75	0.87	2.13*
H(31) Abstract	12	1.33	1.37	12	1.50	1.00	0.35
H(31) Adequate	12	3.92	1.24	12	4.75	1.36	1.57
H(32) (-)	12	1.50	1.38	12	0.42	0.67	2.43
H(32) Abstract	12	2.83	1.90	12	4.17	1.64	1.84
H(32) Adequate	12	2.67	1.37	12	2.42	1.38	0.59
NONTHING ITEM SCORES							
H(11)	12	-	-	12	-	-	-
H(12) (-)	12	8.42	1.44	12	7.75	1.42	1.15
H(12) Abstract	12	1.25	1.30	12	1.08	0.67	0.40
H(12) Adequate	12	0.33	0.49	12	1.17	1.27	3.38**
H(21) (-)	13	7.38	1.61	11	7.91	1.04	0.93
H(21) Abstract	13	0.77	0.73	11	0.73	0.47	0.15
H(21) Adequate	13	1.85	1.35	11	1.36	1.28	0.92
H(22) (-)	13	7.00	1.68	11	6.00	2.65	1.12
H(22) Abstract	13	2.31	1.70	11	2.64	1.50	0.51
H(22) Adequate	13	0.69	0.75	11	1.36	2.06	1.09
H(31) (-)	12	6.42	2.15	12	4.83	1.70	2.01
H(31) Abstract	12	1.42	1.78	12	2.08	1.31	1.03
H(31) Adequate	12	2.17	1.53	12	3.08	1.68	1.38
H(32) (-)	12	5.33	1.92	12	3.92	1.78	1.88
H(32) Abstract	12	3.50	1.51	12	4.75	2.05	1.71
H(32) Adequate	12	1.08	1.04	12	1.33	0.89	0.62

Table A-VI-26. Moran Word Tests: Similarities. Deaf Age Groups by Testing Session, Comparison of Means and Significance of Differences.

		First Session			Second Session			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(2)	(-)	19	-	-	19	13.68	2.00	-
D(2)	Abstract	19	-	-	19	1.11	1.37	-
D(2)	Adequate	19	-	-	19	2.21	1.55	-
D(3)	(-)	24	10.08	3.32	24	11.21	3.32	1.68
D(3)	Abstract	24	1.96	1.396	24	1.96	2.01	0.00
D(3)	Adequate	24	4.25	2.23	24	3.83	2.03	0.68
THING ITEM SCORES								
D(2)	(-)	19	-	-	19	4.68	1.42	-
D(2)	Abstract	19	-	-	19	0.74	0.81	-
D(2)	Adequate	19	-	-	19	1.58	1.43	-
D(3)	(-)	24	3.92	1.67	24	3.08	1.58	1.79
D(3)	Abstract	24	0.88	0.68	24	0.79	1.22	0.32
D(3)	Adequate	24	1.92	1.31	24	3.13	1.11	3.46**
NONTHING ITEM SCORES								
D(2)	(-)	19	-	-	19	9.00	1.00	-
D(2)	Abstract	19	-	-	19	0.37	0.76	-
D(2)	Adequate	19	-	-	19	0.63	0.60	-
D(3)	(-)	24	6.38	2.28	24	8.13	2.19	2.69*
D(3)	Abstract	24	0.96	1.00	24	1.17	1.20	0.66
D(3)	Adequate	24	2.25	1.73	24	0.71	1.33	3.42**

Table A-VI-27. Moran Word Tests: Similarities. Deaf Age Groups by Boys and Girls, C mparison of Me ns and Significance of Differences.

Group	Sub-score	Boys N	Boys $\bar{X}$	Boys SD	Girls N	Girls $\bar{X}$	Girls SD	t
TOTAL SCORES								
D(22)	(-)	10	13.70	1.64	9	13.67	2.45	0.03
D(22)	Abstract	10	1.30	1.83	9	0.89	0.60	0.64
D(22)	Adequate	10	2.00	1.15	9	2.44	1.94	0.61
D(31)	(-)	15	10.20	4.11	9	9.89	1.62	0.21
D(31)	Abstract	15	1.93	1.53	9	2.00	1.22	0.12
D(31)	Adequate	15	3.73	2.43	9	5.11	1.62	1.50
D(32)	(-)	15	10.40	3.81	9	12.56	2.24	1.54
D(32)	Abstract	15	2.40	2.26	9	1.22	1.30	3.58**
D(32)	Adequate	15	4.20	2.37	9	3.22	1.20	1.15
THING ITEM SCORES								
D(22)	(-)	10	4.60	0.96	9	4.78	1.85	0.27
D(22)	Abstract	10	0.80	1.03	9	0.67	0.50	0.35
D(22)	Adequate	10	1.60	1.17	9	1.56	1.74	0.06
D(31)	(-)	15	3.60	1.99	9	4.44	0.73	1.20
D(31)	Abstract	15	0.80	0.56	9	1.00	0.87	0.71
D(31)	Adequate	15	2.13	1.46	9	1.56	1.01	1.02
D(32)	(-)	15	2.80	1.47	9	3.56	1.74	1.15
D(32)	Abstract	15	1.00	1.41	9	0.44	0.73	1.10
D(32)	Adequate	15	3.20	1.08	9	3.00	1.22	0.42
NONTHING ITEM SCORES								
D(22)	(-)	10	9.10	1.20	9	8.89	0.78	0.45
D(22)	Abstract	10	0.50	0.97	9	0.22	0.44	0.80
D(22)	Adequate	10	0.40	0.52	9	0.89	0.60	1.88
D(31)	(-)	15	6.60	2.50	9	6.00	1.94	0.61
D(31)	Abstract	15	1.13	1.13	9	0.67	0.71	1.10
D(31)	Adequate	15	1.60	1.45	9	3.33	1.66	2.66*
D(32)	(-)	15	7.60	2.59	9	9.00	0.87	1.57
D(32)	Abstract	15	1.40	1.40	9	0.78	0.66	1.24
D(32)	Adequate	15	1.00	1.60	9	0.22	0.44	2.16*

Table A-VI-28. Moran Word Tests: Similarities. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

		Day School			Resident School			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
TOTAL SCORES								
D(22)	(-)	6	13.17	2.32	13	13.92	1.89	0.75
D(22)	Abstract	6	.67	.82	13	1.31	1.55	0.94
D(22)	Adequate	6	3.17	1.60	13	1.77	1.36	1.98
D(31)	(-)	13	10.54	4.52	11	9.55	1.37	0.70
D(31)	Abstract	13	1.31	1.25	11	3.18	1.40	3.46**
D(31)	Adequate	13	3.85	2.91	11	4.27	1.35	0.44
D(32)	(-)	13	11.00	3.65	11	11.45	3.30	0.31
D(32)	Abstract	13	1.69	1.32	11	2.27	2.65	0.70
D(32)	Adequate	13	4.31	2.46	11	3.27	1.27	1.26
THING ITEM SCORES								
D(22)	(-)	6	4.00	1.26	13	5.00	1.41	1.48
D(22)	Abstract	6	.17	.41	13	1.00	.82	1.23
D(22)	Adequate	6	2.83	.98	13	1.00	1.22	2.21*
D(31)	(-)	13	4.23	2.05	11	3.55	1.04	0.84
D(31)	Abstract	13	.54	.66	11	1.36	.50	3.38**
D(31)	Adequate	13	1.69	1.55	11	2.09	1.14	0.71
D(32)	(-)	13	3.15	1.52	11	3.00	1.73	0.23
D(32)	Abstract	13	.38	.65	11	1.27	1.56	1.88
D(32)	Adequate	13	3.46	1.13	11	2.73	1.01	1.65
NONTHING ITEM SCORES								
D(22)	(-)	6	9.17	1.17	13	8.92	.95	0.50
D(22)	Abstract	6	.50	.55	13	.31	.85	0.50
D(22)	Adequate	6	.33	.82	13	.77	.44	1.54
D(31)	(-)	13	6.77	2.77	11	5.91	1.51	0.92
D(31)	Abstract	13	.54	.97	11	1.36	.92	2.11*
D(31)	Adequate	13	1.92	2.06	11	2.73	1.49	1.08
D(32)	(-)	13	7.85	2.38	11	8.45	2.02	0.66
D(32)	Abstract	13	1.31	.95	11	1.00	1.48	0.62
D(32)	Adequate	13	.85	1.68	11	.55	.82	0.54

Table A-VI-29. Moran Word Tests: Similarities. Hearing and Deaf Subjects by Age Group Comparisons, *t* Values.

	Scores: Total Score	Scores: Thing Score	Scores: Nonthing Score	Scores: Total Score	Scores: Thing Score	Scores: Nonthing Score
HEARING GROUPS:	H(11)-H(21):CA 6-9			H(12)-H(21):CA 8-9		
(-)	-	7.51**	-	1.26	0.51	1.10
Abstract	-	-	-	2.14*	1.73	1.83
Adequate	-	7.38**	-	2.58*	1.54	2.54*
HEARING GROUPS:	H(12)-H(22):CA 8-11			H(21)-H(31):CA 9-12		
(-)	3.17**	1.77	2.86**	3.67**	2.40*	3.92**
Abstract	4.30**	3.36**	3.33**	4.42**	4.04**	2.94**
Adequate	0.00	0.86	0.68	1.26	0.30	2.33*
HEARING GROUPS:	H(22)-H(31):CA 11-12			H(22)-H(32):CA 11-14		
(-)	1.55	1.28	1.48	3.19**	2.03*	3.18**
Abstract	1.63	1.18	1.54	3.75**	3.31**	3.34**
Adequate	3.79**	2.38*	3.62**	1.11	2.10*	0.58
DEAF GROUPS:	D(22)-D(31):CA 11-12			D(22)-D(32):CA 11-14		
(-)	4.09**	1.58	4.60**	2.81**	3.40**	1.58
Abstract	2.02*	0.64	2.11*	1.57	0.15	2.50*
Adequate	3.40**	0.81	3.95**	2.89**	3.97**	0.24
DEAF AND HEARING GROUPS:	D(22)-H(11):CA 11-6			D(22)-H(12):CA 11-8		
(-)	-	2.52**	-	3.89**	4.20**	2.36*
Abstract	-	-	-	1.43	0.27	2.86**
Adequate	-	0.77	-	3.38**	4.72**	0.46
DEAF AND HEARING GROUPS:	D(22)-H(21):CA 11-9			D(22)-H(22):CA 11-11		
(-)	4.96**	4.70**	3.70**	6.42**	6.51**	4.56**
Abstract	0.40	1.88	1.90	4.81**	2.92**	5.23**
Adequate	5.95**	6.00**	3.03**	3.50**	4.09**	1.03

Table A-VI-29(continued). Moran Word Tests: Similarities. Hearing and Deaf Subjects by Age Group Comparisons, $\underline{t}$ Values.

	Scores			Scores		
	Total Score	Thing Score	Nonthing Score	Total Score	Thing Score	Nonthing Score
DEAF AND HEARING GROUPS:	D(31)-H(11):CA 12-6			D(31)-H(12):CA 12-8		
(-)	-	4.12**	-	0.97	2.68*	3.09**
Abstract	-	-	-	0.63	0.95	0.75
Adequate	-	1.60	-	0.97	4.46**	4.29**
DEAF AND HEARING GROUPS:	D(31)-H(21):CA 12-9			D(31)-H(22):CA 12-11		
(-)	0.13	3.18**	2.27*	1.88	4.72**	0.25
Abstract	2.78**	2.95**	0.88	3.82**	3.03**	3.85**
Adequate	2.69*	6.05**	1.38	0.20	3.65**	2.66*
DEAF AND HEARING GROUPS:	D(31)-H(31):CA 12-12			D(32)-H(11):CA 14-6		
(-)	3.40**	6.36**	1.21	-	6.22**	-
Abstract	2.28*	1.93	2.14*	-	-	-
Adequate	4.11**	6.18**	0.78	-	5.15**	-
DEAF AND HEARING GROUPS:	D(32)-H(12):CA 14-8			D(32)-H(21):CA 14-9		
(-)	0.33	1.04	0.09	1.40	1.56	0.94
Abstract	0.50	0.40	0.00	2.17*	1.79	1.50
Adequate	0.41	1.59	0.11	3.14**	3.33**	2.36*
DEAF AND HEARING GROUPS:	D(32)-H(22):CA 14-11			D(32)-H(31):CA 14-12		
(-)	3.07**	2.96**	7.95**	4.61**	4.46**	4.03**
Abstract	3.49**	2.73**	3.15**	1.98	1.80	1.45
Adequate	0.87	0.68	0.71	4.89**	3.33**	4.36**
DEAF AND HEARING GROUPS:	D(32)-H(32):CA 14-14					
(-)	6.33**	6.07**	5.83**			
Abstract	7.09**	5.89**	6.43**			
Adequate	0.15	1.64	1.52			

Table A-VI-30. Moran Word Tests: Analogies. Hearing and Deaf Age Groups by Testing Session, Comparison of Means and Significance of Differences.

	First Session			Second Session			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
H(1)	24	-	-	24	3.88	1.62	-
H(2)	24	4.79	2.28	24	5.71	2.22	1.42
H(3)	24	6.83	1.88	24	8.46	2.00	2.91**
D(2)	19	-	-	19	2.05	1.81	-
D(3)	24	2.75	1.51	24	2.50	2.28	0.45

Table A-VI-31. Moran Word Tests: Analogies. Hearing and Deaf Age Groups by Boys and Girls, Comparisons of Means and Significance of Differences.

	Boys			Girls			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
H(12)	12	3.33	1.30	12	4.42	1.78	1.70
H(21)	13	5.15	2.30	11	4.36	2.29	0.84
H(22)	13	5.54	2.54	11	5.91	1.87	0.40
H(31)	12	6.42	1.44	12	7.25	2.22	1.10
H(32)	12	8.25	2.22	12	8.67	1.82	0.50
D(22)	10	2.50	1.90	9	1.55	1.67	1.16
D(31)	15	3.13	1.36	9	2.11	1.62	1.64
D(32)	15	2.47	2.70	9	2.56	1.51	0.09

Table A-VI-32. Moran Word Tests: Analogies. Deaf Age Groups by Day and Resident School Enrollment, Comparison of Means and Significance of Differences.

		Day School			Resident School			
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	*t*
D(22)	CA:11	6	4.16	.75	13	2.29	1.19	3.52**
D(31)	CA:12	13	3.00	1.58	11	2.45	1.44	.88
D(32)	CA:14	13	3.00	2.58	11	1.91	1.81	1.18

Table A-VI-33. Moran Word Tests: Analogies. Hearing, Deaf and Deaf Versus Hearing Age Groups, *t* Values.

	CA	*t* Value
HEARING GROUPS:		
H(12)-H(21)	8-9	1.59
H(22)-H(31)	11-12	1.90
H(12)-H(22)	8-11	3.26**
H(21)-H(31)	9-12	3.34**
H(22)-H(32)	11-14	4.51**
DEAF GROUPS:		
D(22)-D(31)	11-12	1.40
D(22)-D(32)	11-14	0.70

	CA	*t* Value
DEAF AND HEARING GROUPS:		
D(22)-H(22)	11-11	5.81**
D(31)-H(31)	12-12	8.88**
D(32)-H(32)	14-14	9.61**
D(22)-H(12)	11-8	3.52**
D(22)-H(21)	11-9	4.28**
D(31)-H(12)	12-8	2.50*
D(31)-H(21)	12-9	3.64**
D(31)-H(22)	12-11	5.38**
D(32)-H(12)	14-8	2.42*
D(32)-H(21)	14-9	3.46**
D(32)-H(22)	14-11	4.94**
D(32)-H(31)	14-12	7.10**

CONSERVATION OF NUMBER

Total Score: ____

Subject: Code No: Scorer: Stage:

Order of Tasks	Prediction	#	Verification: Counting	Verification: Verification	Explanations		I	R
2 similar bunches	More Less Same				I don't know Same			
2 tall glasses	More Less Same				I don't know Same number			
Tall glass Medium glass	More Less Same				I don't know Same number			
Lines short long	More Same Less				I don't know Same number			
2 bunches large small	More Same Less				I don't know Same number			
Other	More Less Same				I don't know Same number			

Color choice: red green

CONSERVATION OF SUBSTANCE

Total Score:____

Subject: Code: Scorer: Stage:

Task (E)	Explanations: Different?	Same?	I	R
2 balls				
Disc	1. MORE (LESS)	SAME		
Sausage	2. MORE (LESS)	SAME		
2 pieces	3. MORE (LESS)	SAME		
4 pieces	4. MORE (LESS)	SAME		
8 pieces	5. MORE (LESS)	SAME		
100 pieces	6. MORE (LESS)	SAME		
2 balls				

Color choice: yellow, terra cotta

CONSERVATION OF WEIGHT

Total Score: ____

Subject: Code No: Scorer: Stage:

Task (E)	Explanations		I	R
2 balls	Different?	Same?		
Disc	1. HEAVIER (LIGHTER)	SAME		
Sausage	2. HEAVIER (LIGHTER)	SAME		
2 pieces	3. HEAVIER (LIGHTER)	SAME		
4 pieces	4. HEAVIER (LIGHTER)	SAME		
8 pieces	5. HEAVIER (LIGHTER)	SAME		
100 pieces	6. HEAVIER (LIGHTER)	SAME		
2 balls				

Scales used? Yes____ No____

Color choice: yellow, terra cotta

CONSERVATION OF VOLUME

Total Score: ______

Child's Name: ______ Code No: ______ Scorer: ______ Stage: ______

First ball: A.

B.

C.

2nd ball: A.

B.

C.

Task	A. Prediction	B. Verification	C. Explanation	I	R
Sausage	= red binder I don't know				
2 pieces	= red binder I don't know				
4 pieces	= red binder I don't know				
8 pieces	= red binder I don't know				

Explanation in terms of Weight? ______ Substance? ______ Shape? ______

Illusion? ______ Force of clay? ______ Displacement? ______

Color choice ______

Appendix B

Words With More Than One Meaning (Watts)

Instructions:

Most words have more than one meaning. Think, for example, of the word BRIDGE: we may speak about a bridge over a river and also about the bridge of the nose (quite another kind of bridge); we may speak, too, of the bridge of a violin (still another kind of bridge) and of the game of bridge (which, again, is nothing like the other kinds of bridge).

Here are eight more words which have more than one meaning:

COVER LINE RUN ROUND ROLL POINT HEAD CROSS

1. He gave the nail a blow on the ________ with his hammer.
2. Her speech was greeted with a ________ of applause.
3. Letters between friends often ________ each other in the mail.
4. Don't waste time; make a ________ of doing what you can at once.
5. Blonde hair and blue eyes tend to ________ in our family.
6. In these matters one must learn to draw the ________.
7. It was a treacherous thing to do under ________ of friendship.
8. The storekeeper took a ________ of bills out of his cash register.
9. The money he had won would not ________ his losses.
10. One hundred dollars would be a good ________ sum for such a purpose.
11. Very well, I'll stretch a ________ and let you go with the rest.
12. The cyclist was able to ________ the distance in ten seconds.
13. I hardly think Mary's ________ of luck is likely to continue.
14. You may find teaching dealt with in the encyclopedia under the ________ of education.
15. I hope you will take a strong ________ when you talk to him.
16. To make things worse the ship began to ________ violently.
17. He was above the ordinary ________ of persons for this kind of work.
18. Each of us has his own ________ to bear.
19. Father usually takes the ________ of the table at meals.
20. Her life was one long ________ of pleasure.
21. The man was in the direct ________ of pleasure.
22. What was your ________ in asking such a question at that moment.
23. My father's name was inscribed on the ________ of honour.
24. The ammunition was rushed to the front ________.
25. The cowboys left the town and began to ________ for the open country.
26. It was a time when feeling was apt to ________ high.
27. The child was tired and very ________.
28. The enemy's position was captured at the ________ of the bayonet.
29. The old lady was unable to sign her name, so she was told to make a ________ instead.
30. The lecture was quite above my ________.
31. The watchman made his ________ of the building.
32. The ________ of the drums sounded like distant thunder.
33. The young general was not expected to ________ himself with glory in his first campaign.
34. We usually agree, but that day we were at ________ purposes.

Appendix B

35. What did you think was the main ________ of his argument?
36. A place laid for a person at a meal is sometimes called a ________.
37. The stock market crash was accompanied by a ________ on the banks.
38. No one should expect to ________ his pockets with money in war-time.
39. The soldiers had to account for every ________ of ammunition fired.
40. I like to hear that Scottish boy ________ his r's.

Words With More Than One Meaning

(Watts - Revised for Deaf)

Instructions:

Most words have more than one meaning. Think, for example, of the word BRIDGE: We may speak about a bridge over a river and also about the bridge of the nose (quite another kind of bridge); we may speak, too, of the bridge of a violin (still another kind of bridge) and of the game of bridge (which, again, is nothing like the other kinds of bridge).

Here are five more words which have more than one meaning:

COVER ROLL POINT HEAD CROSS

1. He gave the anvil a blow on the ________ with his hammer.
2. Letters between friends often ________ each other in the mail.
3. It was a treacherous thing to do under ________ of friendship.
4. The storekeeper took a ________ of bills out of his cash register.
5. The money he had won would not ________ his losses.
6. Father usually takes the ________ of the table at meals.
7. What was your ________ in asking such a question at that moment?
8. My father's name was inscribed on the ________ of honour.
9. The cowboys left the town and began to ________ for the open country.
10. The child was tired and very ________.
11. The enemy's position was captured at the ________ of bayonet.
12. The old lady was unable to sign her name, so she was told to make a ________ instead.
13. The ________ of the drums sounded like distant thunder.
14. The young general was not expected to ________ himself with glory in his first campaign.
15. What do you think was the main ________ of his argument?

Appendix B

MORAN WORD DEFINITIONS TEST - SCORING CATEGORIES

(-) Response is inacceptable as definition.

1. No response.

2. Shows incorrect understanding of word meaning.

3. Employs verb expressing action and is nonsense, e.g. "house goes heavy."

4. Referrent is said to equal something associated with it in space or time, e.g. "boat is water."

5. Response word indicates emotional reaction.

6. Stimulus word in any form is employed as part of the response in such a way that understanding of stimulus word is not demonstrated.

7. Response consists of a word often used in connection with the stimulus word but not equivalent in meaning, e.g., <u>big - strong</u>.

8. Stimulus word understood to be a brand name.

9. Stimulus word understood to be a word of the same pronunciation but different in meaning and part of speech, e.g., "add" understood to be "ad" (advertisement).

10. Stimulus word understood to be a word roughly similar in pronunciation, e.g., "master" understood as "mask."

11. Stimulus word is understood to be a word of nearly the same spelling as stimulus word, regardless of pronunciation.

(½+) Response shows partial conceptualization of word meaning.

1. A word referring to a concrete object, a person (master, friend, enemy), or to the diety (God) is defined by a minor incidental use, function or activity of the referent.

2. A word referring to a concrete object, to a person (master, friend, enemy), or to the diety (God) is defined by a minor incidental observable characteristic of the referent.

3. A sentence or phrase is offered to illustrate the meaning of the stimulus word (in lieu of giving a word, phrase or sentence classifiable as a <u>statement of meaning</u>). This applies to "non-thing" referent words only.

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4. A noun or a noun-headed word group is given as an example classifiable under the stimulus word, e.g., car - Ford, for all concrete words.

5. Broad, general category is given for stimulus word, e.g., car - transportation.

(+) Response is fully acceptable (word is clearly and specifically defined).

1. A word referring to a concrete object, to a person (master, friend, enemy), or to the diety (God) is defined by a major use, function, or activity of the referent.

2. A word referring to a concrete object, a person (master, friend, enemy), or to the diety (God) is "defined" by a major ("defining"), characteristic of the referent.

3. Stimulus word is placed in narrowest possible category, e.g., "father-man" rather than "father-person."

4. Subject offers a synonym (or, for all non-thing referent words except "master," "friend," "enemy," and "God", a phrase which can be used accurately as substitute for a stimulus word.

5. Stimulus word is "defined" by the use of an antonym and a negative word such as "no" or "not."

6. A symbol is employed to indicate meaning, e.g., "add = +".

Appendix B

MORAN SYNONYM RECOGNITION TEST [1]

INSTRUCTIONS: After each CAPITALIZED word in this list are a number of words in small print. Underline each of the words in small print that has the same meaning as the word in capital letters. <u>DO NOT GUESS</u>.

1.	HOUSE	property	<u>dwelling</u>	roof	<u>residence</u>	<u>abode</u>	stone	<u>domicile</u>	room
2.	CLOCK	hour	hand	watch	<u>timepiece</u>	(hourter)	<u>chronometer</u>	alarm	set
3.	CLOTHES	pants	<u>garb</u>	<u>apparel</u>	<u>raiment</u>	protection	<u>garment</u>	<u>attire</u>	(parfold)
4.	CAR	<u>auto</u>	<u>carriage</u>	wheels	<u>conveyance</u>	steer	<u>vehicle</u>	(motobile)	ford
5.	DIRT	<u>loam</u>	<u>earth</u>	<u>soil</u>	rock	<u>sod</u>	furrow	mound	clod
6.	BOAT	<u>craft</u>	steam	keel	<u>ship</u>	<u>vessel</u>	(aquater)	canoe	fishing
7.	DOOR	knob	<u>portal</u>	hinge	<u>postern</u>	house	<u>entrance</u>	closing	lock
8.	FOOD	<u>sustenance</u>	steak	tasty	<u>victual</u>	eat	<u>nutriment</u>	necessity	drink
9.	STREET	traffic	<u>road</u>	concrete	avenue	<u>thoroughfare</u>	winding	(alevard)	highway
10.	GARBAGE	used	<u>offal</u>	<u>refuse</u>	can	<u>rubbish</u>	unclean	<u>trash</u>	<u>waste</u>
11.	FRIEND	<u>ally</u>	priest	help	<u>comrade</u>	girl	<u>companion</u>	guard	(panionet)
12.	BIG	potent	<u>voluminous</u>	strong	<u>large</u>	<u>huge</u>	heavy	<u>massive</u>	size
13.	FAITH	Catholic	<u>belief</u>	(Theolust)	<u>trust</u>	Bible	<u>confidence</u>	christian	<u>conviction</u>

[1] Underlined words are correct synonyms; Neologisms are in parentheses.

Appendix B

MORAN SYNONYM RECOGNITION TEST (CONTINUED)[1]

INSTRUCTIONS: After each CAPATILIZED word in this list are a number of words in small print. Underline each of the words in small print that has the same meaning as the word in capita letters. DO NOT GUESS.

14.	COMMAND	order	decree	permit	direct	argue	(demonter)	dictate	enjoin
15.	NEW	modern	change	different	(euvate)	novel	intrude	unique	recent
16.	ADD	increase	augment	weight	append	burden	arithmetic	affix	annex
17.	DANGER	escape	peril	risk	fall	hazard	jeopardy	battle	enemy
18.	ALL	whole	(whelming)	sum	everything	most	entirely	majority	global
19.	STRONG	puissant	stout	whiskey	big	powerful	robust	muscle	sturdy
20.	DEATH	burial	pain	decrease	fear	priest	stop	demise	grief
21.	GOD	Scripture	Creation	Diety	Lord	(Daisis)	Almighty	Bible	Sacred
22.	WISE	scholar	sage	profound	powerful	sapient	perspicacious	(keenital)	erudite
23.	HATE	enmity	enemy	antipathy	detest	(furesty)	torture	abominate	abhor
24.	ENEMY	antagonist	foe	(antisine)	evil	opponent	harmful	thief	wrong
25.	MASTER	overcome	order	chief	ruler	surmount	owner	subjugate	foreman

1 Underlined words are correct synonyms; Neologisms are in parentheses.

Appendix B

MORAN SENTENCE CONSTRUCTION TEST

1. (new)
2. (danger)
3. (clock - garbage)
4. (clothes - boat)
5. (door - food)
6. (car - faith)
7. (house - wise)
8. (dirt - strong)
9. (street - God)
10. (friend - all - master)
11. (big - death - hate)
12. (command - add - enemy)

Appendix B

MORAN SENTENCE CONSTRUCTION TEST - SCORING CATEGORIES

Category	Score
1. Adequate sentence: Stimulus words given are used in correct part of speech in a grammatically acceptable sentence which expresses a logical idea. Changes in number, sense or case are accepted as very minor grammatical errors or compounding of stimulus word.	1
2. Inadequate sentence: Stimulus word(s) not used. 2.1 Stimulus word not used; nothing is substituted for it. 2.2 Stimulus word changed in part of speech (not including changes in tense, number or case) or used as proper noun. 2.3 Supraordinate, subordinate or synonymous word substituted for stimulus word. (This classification based on system developed for Word Association and Synonym Recall Tests). 2.4 Phrase substituted for stimulus word. 2.5 Stimulus word misunderstood.	0
3. Inadequate sentence: Sentence not acceptable grammatically. 3.1 Two or more unrelated statements in one sentence-Moran. 3.2 Sentence not a grammatical unit - Moran. 3.3 Miscellaneous grammatical errors of such nature that they cast doubt upon subject's understanding of stimulus word - Moran. 3.4 Two or more separate sentences given. 3.5 Word hash. 3.6 One stimulus word is placed seemingly at random into an otherwise acceptable sentence.	0
4. Inadequate sentence: Grammatically acceptable but expresses an idea considered illogical and/or absurd by one, several of all U.S. subcultures. 4.1 Anthropomorphism. 4.2 Idea contrary to established American cultural patterns. 4.3 Physical properties attributed to an abstraction. 4.4 Abstract properties attributed to an abstraction. 4.5 Sentence is ambiguous and shows confused thought. 4.6 Sentence expresses absurdity.	0
(-) No response.	0

Appendix B

MORAN SIMILARITIES TEST

INSTRUCTIONS: Now I am going to read you some groups of words. I would like you to tell me what the words in each group have in common; that is, in what way are they alike. Example: chair, table.

1. door window		8. God faith Bible	
2. boat train car		9. add subtract divide	
3. clothes house food		10. all none much	
4. street bridge sidewalk		11. hate fear love	
5. stone dirt clay		12. master boss	
6. garbage ash		13. friend enemy	
7. clock ruler		14. strong wise new big	
		15. command ask teach	
		16. death stop tip	
		17. danger gambling	

MORAN ANALOGIES TEST [1]

INSTRUCTIONS: each of the lines in this test, the first two words fit each other in a definite way. You are to draw a line under the one word in CAPITAL letters that best fits the third word in the same way that the first two fit each other. Examples:

DARK	is to LIGHT	as BLACK	is to RED	GREEN	WHITE	BLUE
FOOT	is to SHOE	as HAND	is to THUMB	HEAD	GLOVE	FINGER
EAT	is to BREAD	as DRINK	is to WATER	THIRSTY	SWALLOW	TASTE

1.	ADD	is to SUBSTRACT	as ALL	is to EVERY	NOTHING	PLUS	EACH
2.	BOAT	is to WATER	as CAR	is to FLOAT	LAND	WHEELS	RIDE
3.	CLOCK	is to WATCH	as GARBAGE	is to TIME	CAN	TRASH	WIND
4.	HOUSE	is to ROOF	as STREET	is to CURB	ROAD	CAR	STAIR
5.	DIRT	is to PLANT	as FOOD	is to GROW	SEED	HUMAN	EAT
6.	GOD	is to FAITH	as ENEMY	is to LOVE	HARM	BIBLE	HATE
7.	DOOR	is to BUILDING	as BUTTON	is to BONE	ROOF	CLOTHES	HANDLE
8.	STRONG	is to BODY	as WISE	is to POWER	MIND	MUSCLE	CLEVER
9.	MASTER	is to COMMAND	as FRIEND	is to FEAR	HELP	ORDER	ENEMY
10.	NEW	is to AGE	as BIG	is to OLD	ELEPHANT	SIZE	STRONG
11.	DANGER	is to FEAR	as DEATH	is to BURIAL	SICKNESS	PRIEST	GRIEF

1 Correct responses are underlined.

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